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Contents.

	PAGE
The Utility of International Congresses	349
Attractive Foundries	350
The Production and Uses of Ni-Cr-Fe and Co-Cr-Fe Castings	351
Welfare and Self-Help in the Iron and Steel Industry	355
Institute of British Foundrymen	360, 354, 356
Advantages of Foundry Control	357
A Note on Fillets	359
Discussion on Mr. Gill's Paper on Blast Furnace Practice at Consett Iron Company, Limited	360
Vocational and Technical Instruction in Relation to the Foundry Trade	362
Oil Sand Cores and Moulds	364
Correspondence	365
Trade Talk	366
Company Reports	366
Patent Specification	366
Foundry Query	368
Iron and Steel Markets	368

Forthcoming Events.

APRIL 29.

Institution of Engineering Inspection:—Ordinary meeting in London. Paper will be read by L. H. Evans on "The Stress-Strain Diagram and its Application to the Testing of Rolling Stock Drawgear."

Institution of Mechanical Engineers:—General meeting in London. "The Failure of Some Steel Wires under Repeated Torsional Stresses at Various Mean Stresses," Paper by Professor F. C. Lea, O.B.E., D.Sc. (M.), and F. Heywood, M.Sc.

Institute of Metals (Swansea Local Section):—Annual general meeting.

Institute of British Foundrymen.

APRIL 30.

London Junior Branch:—Visit to Research Laboratories and annual meeting in London.

Newcastle-on-Tyne Branch:—Annual general meeting. Discussion on "Foundry Problems," by W. J. Paulin.

West Riding of Yorkshire Branch:—Annual general meeting at Bradford.

MAY 7.

Lancashire Branch:—Ordinary meeting at Manchester. "Some Aspects of Foundry Work," Paper by E. Longden.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

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Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Utility of International Congresses.

We confess that sometimes we have doubted whether the results obtained from international meetings of foundrymen were commensurate with the trouble and time expended upon them, but after a recent visit to the Brussels Congress of the Belgian Association we are convinced that they must result in true technical progress. We base our observations on the following grounds; precisely similar problems are besetting the industry in each country. For instance, there is not merely a national shortage of apprentice foundrymen, but a universal one. M. Soupart, a Belgian authority, imagines that these conditions would be ameliorated by constituting a special higher grade technical college, similar to the Ecole Superieur de Fonderie at Paris, together with a co-operative effort to train apprentices in foundries incapable of carrying the universally accepted quota of 10 per cent., by transferring them from one establishment to another during their period of training.

Another factor which makes international meetings worth while, is that each nation has developed more than others in certain branches of the industry. America, in a general way, knows more of quantity production than is the case in Europe. The Belgian foundries have realised economies in production rarely equalled by her competitors. Most countries can teach Britain much about the production of chilled castings. On the other hand, Britain excels in the production of pipe whether centrifugally or statically cast. In marine and textile castings Britain is recognised as being the premier producer, whilst in electric castings, so far as very large and very small ones are concerned, an excellent quality is turned out, which is probably superior to foreign manufacture.

Germany carries out very extensive research work into the nature of cast iron, and there are probably in that country a larger number of metallurgists devoting their energies to this work than elsewhere.

This recital is not made with the object of praising or disparaging national effort, but definitely with the object of illustrating the benefits to be derived from international meetings of foundrymen.

Obviously, the international exchange papers, owing to national prestige being at stake, are of the highest quality, and it is rather to be deplored that no complete collection exists in a handy form. However, we are inclined to the view that if sufficiently strong representation was made to the Carnegie Trustees, such a volume would be forthcoming. This is certainly worthy of consideration by the newly-formed International Foundry Committee.

As the various nationals become better acquainted, there will be every chance of standardising internationally the tests to be specified for cast products, with the total elimination of such mistakes as were made at the Pan-American Congress, held some months back for the proposed adoption by South American countries of United States specifications whilst ignoring the existence of European suppliers.

Institute of British Foundrymen.

Annual Conference in Sheffield.

The arrangements for the annual Conference to be held at Sheffield from July 5 to 9, 1927, are now well in hand. A number of important Papers are being prepared for the Conference, and these will include the following three Papers which are being prepared on behalf of the foreign foundrymen's Associations:—"The Properties of Coke Affecting Cupola Melting of Steel," by Mr. J. T. MacKenzie, chief chemist of the American Cast-Iron Pipe Company, Birmingham, Ala., U.S.A. (This is presented on behalf of the American Foundrymen's Association.) "Some Methods of Making Steel Castings," by Georges Fosseprez. (Presented on behalf of the Belgian Foundrymen's Association.) "The Manufacture of Steam-Engine Cylinders, etc.," by M. Audo, manager of the workshops of the Paris-Orleans Railway. (This Paper is presented on behalf of the French Foundrymen's Association.)

A strong local committee is making arrangements for a number of works visits and social events, and an attractive ladies' programme is being arranged.

The Secretary of the Conference Committee is Mr. W. A. Macdonald, 219, Ringinglow Road, Ecclesall, Sheffield.

Attractive Foundries.

Can the foundry be made really attractive? The question is important because it is generally recognised that there is to be a shortage of foundrymen of the better sort in the near future. Foundries suffer from having a large proportion of poor-grade labour, and all sorts of theories have been advanced for remedying this. Boys from the public and secondary schools are often scared away from the foundry, despite its scientific appeal, because of the conditions and the environment.

We have seen foundries which had white-tiled walls that were washed down periodically, and with ventilation and lighting systems that were almost perfect, but it is difficult to see how a foundry, even when well managed and excellently laid out, can be other than a disagreeable place to the fastidious. In a repetition foundry, where the work is all done by moulding machines or on benches, a certain degree of tidiness and even cleanliness is possible; but what of the jobbing foundry with its multifarious tackle, which will undertake anything from the link of a chain to the stern frame of a ship? It must always resemble an earthquake in miniature.

Idealism is all very well, but we should face facts. The right class of boy labour will only be attracted to it by making it more scientific and by making it easy for him to bridge the gulf between the foundry floor and the laboratory. Complaint is sometimes made that the chemist is dominating the foundry. This will continue to be until the foundryman himself becomes a chemist.

It is but right to remember that, while the chemist has improved the quality of the foundry product, the genius of the engineer has made the conditions pleasanter by the invention not only of moulding machines but of handling contrivances. The foundry may not be as pleasant in some ways as other departments, but if the conditions are made as pleasant as is practicable a really good class of lad should be attracted.

J. M.

American Exchange Paper.

The Official Exchange Paper presented on behalf of the Institute of British Foundrymen to the Conference of the American Foundrymen's Association, which will be held in June next in Chicago, has been prepared by Professor J. H. Andrews, D.Sc., Professor of Metallurgy in the Royal Technical College, Glasgow. The subject of Professor Andrews' Paper is "The Growth of Cast Iron."

Catalogues Received.

Flue Dust Collection.—Whilst perhaps the foundry industry is more concerned with the removal of dust from the grinding department and the pattern shop, we are convinced that they will read with interest a new publication entitled "Achievement," issued by Messrs. Davidson & Company, Limited, Sirocco Engineering Works, Belfast. The statement that the collectors they have supplied are catching 150,000 tons of dust per annum gives one confidence that this firm can be approached with confidence by founders having, as most do, difficult dust-collecting problems. This 16-page brochure is well illustrated, and is a very convincing piece of publicity. It is, we understand, available to our readers on application.

Suspended Furnace Roofs.—The reviewer's personal experience has demonstrated beyond question that if refractory bricks are submitted to pressure they fuse at a much lower melting point and the life of a structure is considerably decreased. It is with pleasure that we note that various attempts are being made to relieve this pressure, by constructing suspended roofs. The latest system to be introduced to the British market is the Karrena, and we are indebted to Messrs. H. W. Venton, Limited, of 32, Queen Victoria Street, London, for sending us along a twelve-page catalogue which illustrates and describes this particular form of shape and arrangement. The advantage of the Karrena form of construction is that the bricks can be easily replaced and that the C.I. girder from which suspension is made is so formed that cooling of the bricks becomes natural, but additionally a system of fan cooling can be incorporated. The system appears to have many practical applications to foundry furnace practice, both for melting, drying and annealing.

Refractories.—There are nearly 100 pages in the latest publication sent out by Messrs. E. J. & J. Pearson, Limited, of Stourbridge. It is bound in dark-green stiff and carries with a sense of dignity which one naturally associates with a house established in 1860. After outlining the services they give, together with a plea for co-operation between manufacturer and consumer, the booklet illustrates the various mines which the company operate. Stock sizes of squares, splits, side and end arches are illustrated and detailed. The analyses and heat tests given on pages 30 and 31 are most interesting. The next section of real interest to our readers is on page 63, where grate and range bricks are illustrated. It is followed by blast-furnace and steelworks special sections. Cupola linings are next dealt with, and information relative to the "G" quality bricks is given. The final section is devoted to "Useful Information," and includes much data relative to temperature, the metric system, mensuration and the like. It will certainly be appreciated by the foundry trade of this country.

Polish Iron Foundries.

In a financial paper, a telegram from Reuter announces that the Syndicate of Polish Iron Foundries has just been enlarged. It now incorporates the whole of the Polish iron industry and comprises fifteen concerns, which are:—

Cracow Iron Foundry, Hutz Bankowa Company, Metallurgical Establishments Company, Hantke Brothers, Moorzejow Establishments, Ostrociec Establishments, Sosnowice Works Tubes & Iron Company, Staracnowice Mining Establishments Company, Stomporkow Company, Basildonstal Company, Friedenshutte (Silesia), Katowice Mines & Foundries Company, Koenigs Unified Foundries, Laurahutte and Bismarckhutte.

These works employ altogether 33,464 men.

New Companies.

Dawkins Light Castings, Limited, Highfields, Bilston.—Capital £14,000 in £1 shares.

Geo. L. Scott & Company, Limited, 69, Fleet Street, E.C.4.—Capital £2,000. Iron, steel and metal merchants and agents.

The Production and Uses of Ni-Cr-Fe and Co-Cr-Fe Castings.*

By J. Ferdinand Kayser, Sheffield, England.

Introduction.

In the course of this communication the author proposes to describe the present position of those Ni-Cr-Fe and Co-Cr-Fe alloys which are suitable for the production of castings and to consider in some detail their future. These alloys vary in price from 3s. per kilo to 10s. per kilo, according to composition and size of the casting, and that is probably the reason why they have been very much ignored.

At the present moment, and for the past few years, the majority of foundries have been working on short time, and the need for new outlets for foundry produce is very necessary. Drop forgings are being used to an ever-increasing extent to replace castings, and whereas, at first, only small simple castings were replaced by them, every year larger and more complicated castings are being replaced by correspondingly larger and more complicated forgings.

In England practically the only method which manufacturers have adopted to extend their business has been that of reducing prices. Up to a certain point that is a sound policy, but driven

Table I.—*Properties of Cr, Fe, Ni, and Co.*

	Cr.	Fe.	Ni.	Co.
Atomic weight ..	52.1	55.85	58.68	58.97
Specific gravity ..	6.74	7.8	8.8	8.8
Melting point ..	1,500°C	1,528°C	1,452°C	1,478°C

to extremes, it is essentially bad from both the producers' and the users' points of view. The profit made by the foundry is necessarily less, and in spite of the very best intentions, there is a great tendency to pass castings which would be scrapped if the business were more remunerative. Besides being bound down by the "low-price" fetish, foundry proprietors, as a whole, seem to desire only work which can be produced from the cupola or the reverberatory furnace, and practically rule out, as of no consequence, metals which necessitate electric melting for large quantities or crucible melting for smaller quantities. Consequently the alloys here described are looked upon as being quite beyond the scope of a large foundry, and engineers who are acquainted with the wonderful, and very varied, properties of the different alloys falling in these two series are not able to obtain castings weighing more than a few hundred pounds.

Iron, nickel and cobalt are, in some ways, very similar metals. All have very nearly the same atomic weight, specific gravity, and melting point, the actual figures, together with those for chromium, being given in Table I.

* A Paper, read before the Brussels Congress of the Belgian Foundrymen's Association, M. Paul Ropsy presiding.

Whilst the alloys here described contain small percentages of other essential constituents besides nickel, chromium and iron in the one case, and cobalt, chromium and iron in the other case, yet the compositions of the commercially useful alloys and, to a somewhat less extent, their properties, can be indicated fairly accurately by zones on an equilateral triangle. Diagrams Nos. 1 and 2 show two such triangles, the three corners corresponding in one case to pure nickel, iron and chromium respectively, and to cobalt, iron and chromium respectively in the other case. Compositions which have already found commercial applications are indicated by black dots. The shaded zones represent the compositions of alloys with useful, but not in every case economical, properties. The dotted zones represent alloys for which no use has yet been found. In both series the presence of a high percentage of chromium renders them extremely hard and brittle without enhancing any other property. It will be noted that commercially useful alloys in both diagrams are in approximately the same relative positions, but the uses of alloys occupying corresponding positions are widely different. All the alloys falling within the shaded zones are more or less resistant to corrosion at ordinary temperatures and to oxidation at any temperature up to 100 to 1,050 deg. C. On the other hand, a series of alloys which, in the case of the nickel series, are only useful for the above purpose and are very nearly non-magnetic, give a series of alloys capable of being used as high-grade permanent magnets when the nickel is replaced by cobalt.

Tables II and III give the compositions of alloys which are at present being produced in the form of castings.

Ni-Cr-Fe Alloys.

Tests show that, almost without exception, the Ni-Cr-Fe series of alloys is remarkably resistant to chemical attack and the compositions falling within the shaded zone possess considerable strength at high temperatures, besides which they are practically immune from oxidation at all temperatures below 1,050 deg. C.

Table II.—*Composition of Alloys used in Commerce.*

	Country of Origin.	Ni.	Cr.	Fe.	C.	Si.	Mn.	Cu.
(1)	England	64.9	19.86	11.8	0.63	1.80	1.08	Nil.
(2)	,, ...	64.9	15.5	15.8	1.13	—	—	—
(3)	,, ...	62.0	9.7	Dif.	0.83	—	—	—
(4)	,, ...	62.7	10.84	Dif.	0.68	0.22	1.44	0.11
(5)	,, ...	59.9	13.2	23.2	0.6	1.17	1.88	Nil.
(6)	,, ...	40.0	9.0	Dif.	1.4	0.33	2.1	5.4
(7)	,, ...	57.5	13.68	27.3	0.5	0.80	0.79	Nil.
(8)	U.S.A.	20.0	7.5	Dif.	0.45	1.00	0.75	Nil.
(9)	,, ...	35.0	15.0	Dif.	0.80	—	—	—
(10)	,, ...	40.0	5.5	49.6	—	—	—	— Al 4.1
(11)	,, ...	0.0	18.0	Dif.	1.50	—	—	—
(12)	,, ...	25.0	15.0	57.5	0.50	1.50	0.50	—
(13)	,, ...	25.0	—	73.2	—	—	—	—
(14)	,, ...	0.5	15.0	Dif.	3.5	0.8	0.3	Nil.
(15)	England	Nil.	13.7	Dif.	0.06	0.08	0.1	Nil.
(16)	,, ...	Nil.	13.5	Dif.	0.4	0.08	0.1	Nil.
(17)	,, ...	Nil.	15.0	Dif.	3.5	0.8	0.3	Nil.
(18)	,, ...	0.5—3.5	12.0	Dif.	1.5	0.8	0.3	Nil.
(19)	,, ...	6—35	10.0	Dif.	1.0	0.5	0.2	Nil.

The simplest alloys of the series contain from 12 to 15 per cent. of chromium and up to 3.5 per cent. of carbon. The alloys low in carbon, say under 1 per cent., are extremely difficult to cast in the foundry, but when they can be produced sufficiently low in carbon and impurities, show a remarkable resistance to rusting and general atmospheric corrosion. As the carbon is increased the resistance to corrosion in the untreated state becomes less until, with about 0.2 per cent. or more of carbon present, it is necessary to harden the castings before they can be looked upon as being stainless. It is often stated that when the

carbon exceeds about 0.4 per cent., the stainless properties are not so good. Such, however, is not the case, although it becomes increasingly necessary carefully to harden them in order to obtain satisfactory results. None of these Co-Cr-Fe alloys is resistant to corrosion unless they have a ground, or better still, a polished surface. In this country they have not yet found a very big outlet. They are used, to a small extent, for a very large number of different purposes, particularly for valves (including domestic taps) and parts of chemical plant.

Alloys containing from 1 to 3.5 per cent. of carbon and about 14 per cent. of chromium have been extensively used for the production of blanking tools for stamping and cutting sheet metals, milling cutters, drawing ties, etc. In the "as cast" condition they give a Brinell hardness of about 450 and have an Austenitic structure. After treatment at 750 deg. C. the hardness is reduced to about 270 Brinell, in which condition machining operations can be readily performed. The finished tools may then be hardened by quenching in oil from 950 deg. C. The presence of 7 per cent. of chromium or more completely prevents the separation of free carbon in any form, and that, after the most drastic annealing, the fracture is always white.

The addition of nickel to any of the above alloys very much increases the resistance to corrosion and their strength at high temperatures. Alloys containing 15 per cent. of nickel and upwards, together with not less than 7 per cent. of chromium or 15 per cent. of chromium and not less than 10 per cent. nickel, possess corrosion-resisting properties without being polished or heat-treated, and, ultimately, when one comes to alloys falling within the zone *abc*, they are not only resistant to numerous chemicals and atmospheric corrosion at normal temperatures, but also possess remarkable properties at high temperatures.

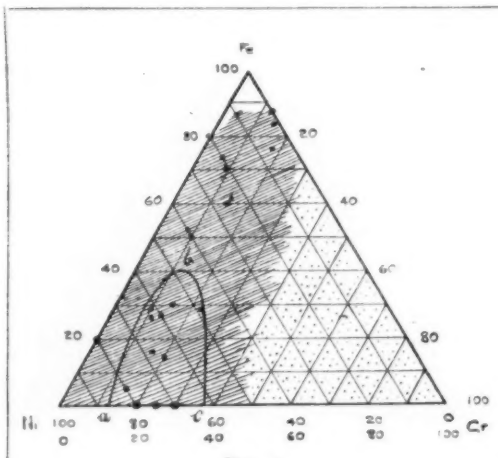

Fig. 1.

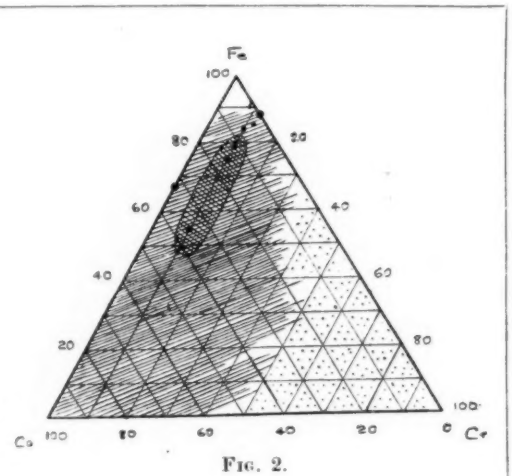

Fig. 2.

The tensile properties of the alloys can be varied within very wide limits by a suitable alteration in composition. Alloy No. 1, for instance, gives a maximum stress in the cast state of from 25 to 30 tons per sq. in., and an increase in the chromium at the expense of the nickel and the iron to the extent of a further 10 per cent. raises the maximum stress to approximately 35 to 40 tons per sq. in. Practically all the alloys are capable of being softened and rendered more ductile by heat treatment and, in that respect, behave as most non-ferrous alloys, *i.e.*, they become more ductile when quenched.

For some years trade pamphlets have given details concerning the physical properties of various alloys at high temperatures, in every case claiming a very considerable tensile strength at temperatures of 800 deg. C. and upwards, and until the publication of Dickenson's Paper before the Iron and Steel Institute practically no other figures were available.

Dickenson clearly showed that, at high temperatures, steels and alloys behave like viscous fluids, and cannot be said to have any definite tensile strength. Thus a statement in a trade pamphlet that at 1,000 deg. C. a certain nickel-chromium alloy has a tensile strength of 10 tons per sq. in., and that at the same temperature mild steel shows a tensile strength of 4 tons per sq. in., is not only without meaning, but is misleading. Actual experiment has shown that at 1,000 deg. C. such nickel-chromium alloy would stretch continuously until rupture occurred if stressed to less than half that load. Dickenson gives a large number of results, but the following are sufficient for the purpose of this Paper.

At 550 to 600 deg. C., under a load of 8.5 tons per sq. in., a 0.45 carbon steel broke in 195 hrs.; a nickel-chromium steel broke in 88 hrs.; a 14.7 per cent. chromium steel broke in 1.728 hrs.; a high speed steel was withdrawn after 2,002 hrs., and its probable life estimated at 25,000 hrs.; and a nickel-chromium alloy was withdrawn after 3,604 hrs., and its probable life estimated at 108,120 hrs. (An estimate of the probable life, had the tests proceeded, was made by comparing the time required to produce the same extension in unbroken and broken samples of the same alloy, assuming that the extension-time curves would have the same form in each case.)

At 700 to 750 deg. C., under a load of 8.5 tons per sq. in., the 14.7 per cent. chromium steel broke in 3 mins.; the high-speed steel broke in 21 hrs.; and the nickel-chromium alloy broke in 273 hrs.

Alloys falling within the zone *abc* are very well known in the United States of America and are somewhat less well known in England. Up to the present they have found extensive application for the manufacture of metallic parts which are subject to stress or oxidising conditions at elevated temperatures, such as case-hardening boxes, salt pots, furnace parts, gas-burners, cloth singeing plates, internal combustion-engine parts, etc. So far as the author knows, the largest casting yet produced weighed approximately 2½ tons, but now no English plant produces castings weighing more than about half a ton.

If the nickel in these alloys is replaced by cobalt, they have essentially similar properties in so far as strength, resistance to corrosion and resistance to oxidation at high temperatures are concerned. Cobalt being, however, approximately six times dearer than nickel, it is never used in place of that metal.

Co-Cr-Fe Alloys.

An alloy containing approximately 12 per cent. of chromium, 1.4 per cent. of carbon and cobalt varying from 1 to 6 per cent. has been patented in several countries as a substitute for high-speed steel. During the war, many tons of cast milling cutters and other small tools were produced containing 3.5 per cent. cobalt and, although the cheapness of tungsten and the superior cutting efficiency of a tungsten cutter has in many cases rendered them uneconomical, there are still numerous instances in which tools for stamping

sheet metal, etc., can advantageously be made from such alloy-castings.

The very latest type of casting produced from this series of alloys is the cast magnet. The useful compositions fall within the doubly-shaded zone in Fig. 2. The de-magnetising loop of a cobalt steel magnet containing 9 per cent. cobalt is shown in Fig. 3. It will be noted that the coercive force is 175 and the BHmax 500,000 compared to a coercive force of 60 and a BHmax of approximately 250,000 given by ordinary tungsten steel magnets. By an increase in the cobalt content to 36 per cent., a BHmax of 900,000 can be obtained. Up to date, probably only 30 to 40 tons of cast magnets have been produced, but their production is still in its infancy. The largest number of castings have been in the form of small cast letters, which are hardened and magnetised and used as advertisement signs. The letters range in height from ¼ in. to 2 in. high and vary in weight from approximately 3 gms. to 60 gms. Many thousands of cast magnets have also been absorbed by the wireless industry.

Production of Castings.

The production of castings in any of the alloys above described is very similar. On account of their high cost and the necessity for having a definite analysis, it is quite impossible to use a cupola as a melter and, so far, all the alloys have been melted either in an electric furnace in the case of large castings, or a crucible furnace in the

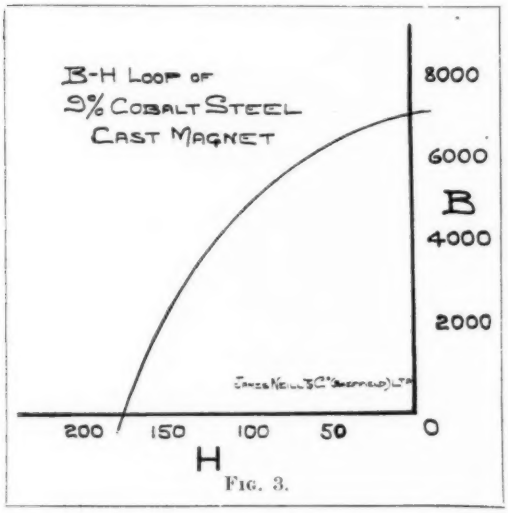

Fig. 3.

case of smaller castings. Castings weighing from approximately 50 gms. up to 500 kilos are regularly produced from coke-fired crucible melting furnaces, the cost of melting varying from 3d. to 4d. per kilo. The moulds for the smaller castings, whether made for one of the nickel alloys or one of the cobalt alloys, are best made as if for malleable iron, but the gates and runners must be larger, and the metal must be cast very much hotter. It is preferable to use a facing consisting of a strong sand, such as Mansfield, suitably mixed with a more open sand in accordance with the type and size of the casting.

It is necessary that the moulds and cores should always be carefully and neatly made, and the sand mixture used must be one which produces clean surfaces. In the case of both series of alloys, castings less than 10 mm. thick can be produced quite free from any adhering sand.

Fig. 4 shows a spray of small castings removed from the sand and brushed without any attempt to fettle. It should be particularly noted that, although cast at a temperature usually used for casting steel, they are quite as clean as ordinary malleable-iron castings cast at a much lower heat.

The production of alloys of the Ni-Cr-Fe series was started on a small scale, probably about the year 1912, and of the Co-Cr-Fe about 1915. From 1915 until approximately 1924, the latter alloy was used only for the production of tools of the nature illustrated in photograph No. 1, but since that date alloys containing from 9 per cent. of cobalt and upwards have been cast into magnets of many different shapes and sizes. Up to the present, the output of both the nickel and the cobalt alloys has been infinitesimally small in comparison to the output of iron and steel castings. It is indeed probable that the tonnage of these special castings will never be more than a fraction of that of the output of the present-day cheaper ferrous metals, but it is highly probable that the value of stainless alloy and magnet castings will, in a few years, equal, if not surpass, that of the ordinary ferrous castings.

Cast Magnets.

Without in any way entering into the theories of permanent magnetism and the design of magnets, it is, for this Paper, sufficient to say that it is quite impossible to design correctly a magnet if only rolled or forged-bar material is available. All magnets should be so designed that the flux density from end to end is uniform, and to achieve that result it is necessary for the cross section of the magnet at the middle to be considerably greater than it is at the ends. It can be seen that the only economical way of making such magnets is by means of castings. On metallurgical grounds, a cast magnet is also very much more desirable than a magnet made from forged or rolled material. It has been shown by various workers, and is now a recognised fact, that prolonged soaking is detrimental to all types of magnet steel. During the process of the production of bars, it is necessary to soak the material for a considerable length of time, otherwise it is almost impossible to forge economically. This long soaking results in a considerable lowering of the remanence and a still greater lowering of the coercive force, both of which factors adversely affect the maximum available energy. A cast magnet can be softened without the necessity for prolonged heating and, consequently, is not liable to any "spoiling." The fact that many cast magnets have a low remanence may seem to contradict this statement, but in order to produce a sufficiently fluid metal it has been necessary to resort to a composition which inherently possesses a great tendency to remain austenitic and, consequently, give a low saturation value and remanence. Experiments at present in hand indicate, however, that before very long, fluid material with a high remanence in the finished state will be available.

It is estimated that at the present moment, with trade very depressed, the production of finished magnets in Europe is something of the nature of 10,000 tons per annum, and of this quantity probably 4,000 tons are produced in England and the balance on the Continent of Europe. With active propaganda there is little doubt but that a very considerable percentage of these magnets, which are all made from tungsten steel or chromium steel, could be replaced by cast cobalt steel magnets and would result in, say, at least 5,000 tons per annum of small castings being required. Foundry costs for the production of these castings can be reckoned at a minimum of about 3d. per lb., and at that figure would mean a foundry expenditure of £150,000 per annum. The total turnover would probably amount to about £1,400,000. To achieve that result, it will be necessary for foundries to co-operate very closely with highly skilled metallurgists, who in turn will have to have a no mean knowledge of the requirements of the electrical engineer.

Stainless Alloys.

The Ni-Cr-Fe alloys will, it is thought, prove very much more important than the Co-Cr-Fe alloys, and the writer would not at the present moment venture to suggest what rate of production may be reached. At the present, the production of an ordinary Cr-Fe-Co alloy presents considerable difficulties and has not been adopted to a very great extent, though it is interesting to note that one of the tramcars in the city of Sheffield is fitted with stainless-steel fittings, many of which have been made from castings.

The Ni-Cr-Fe alloys, such as those represented by analyses Nos. 1, 2, 3, etc. (Table II), up to the present have been largely used only for those purposes in which advantage is taken of their resistance to scaling and to their superior strength at

high temperatures. It is, however, now recognised by practically all classes of engineers that a very large number of machine parts actually wear out or fail suddenly, due to corrosive action of some type or other, and the advent of Ni-Cr-Fe castings will, in the author's opinion, lead to the almost complete extinction of bronze, monel metal and of similar castings.

When nickel is absent, it is necessary to control the composition very carefully, and in many cases the articles must be heat-treated before use. The introduction of nickel in suitable quantities gives castings which, without heat treatment, are more non-corrosive than Cr-Fe-Co castings and whose properties are not affected by a very considerable variation in composition.

The future of the alloys which have been described in the above paper rests, to a very great extent, in the hands of the technical staff of the foundries but, to a still greater extent, is controlled by the producers of those two most important metals, cobalt and nickel. For a long time it was thought that the more pure the cobalt the more suitable it was for the production of alloys. So far as the alloys described in this paper are concerned, such is not the case, and equally satisfactory results can be obtained by the use of ferro-cobalt as by the use of a technically pure cobalt.

A few years ago the production of ferro-cobalt (which was sold at 3s. 4d. per kilo cheaper than

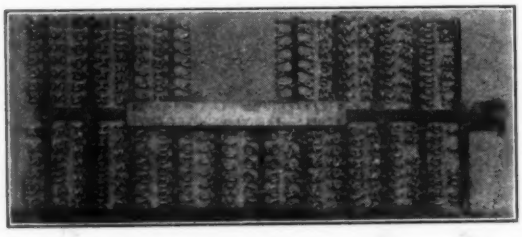

Fig. 4.

metallic cobalt) very much enlarged the field of application of cobalt magnets. At present it is almost impossible to obtain supplies containing less than 97 per cent. of metallic cobalt. If such alloys can be produced cheaply, that does not matter, but the writer would like to impress upon the makers that the use of cobalt would be stimulated to a much greater extent by the manufacture of a cheap, but impure, form of the metal than by the production of a pure, but dearer, form.

When one comes to the Ni-Cr-Fe alloys, the same remarks apply. An exceedingly pure nickel is, without doubt, essential for the typical non-ferrous trades, in which one of the chief requirements is ductility. The properties desired in the Ni-Cr-Fe alloys here described are, however, totally different, and if a cheaper but impure form of nickel could be produced, the writer hopes that the makers will not fail to place their product before the manufacturers of non-corrodible castings. The nickel producers themselves have unfortunately chiefly directed their attention to the production of wire in so far as the Ni-Cr-Fe series of alloys is concerned, and for that purpose the absence of practically every other metal is highly desirable, but for the production of many types of castings, and even of forgings, such is not the case.

The whole future of both the cobalt and nickel alloys is one which will probably have a very great bearing upon the steel industry of the future, and the writer would much appreciate the views, not only of foundrymen and users, but particularly of the producers of cobalt and nickel, upon the opinions which he has expressed.

North-African Iron Ores.—The Compagnie des Minerais de Fer Magnetique de Mokta-el-Hadid of Algeria reports for the past financial year an output of 456,943 tons of iron ore at the Benisaf Mine (compared with 465,908 in 1925). The ore shipments totalled 314,091 (419,022) tons. About 45 per cent. of last year's output was sent to Great Britain, 36 per cent. to the United States, and the balance to France and Germany.

Institute of British Foundrymen.

LONDON BRANCH.

Annual General Meeting.

The annual general meeting of the London Branch was held at the Engineers' Club, Coventry Street, Piccadilly, W.1, on April 14, Mr. Robert J. Shaw (Branch-President) in the chair.

Branch-Secretary's Annual Report.

The Hon. Secretary (Mr. H. G. Sommerfield), in his report for the year 1926-27, said that since his last report the Branch had had an increase of 32 members, and it was gratifying to be able to state that the Branch register now totalled 202, as against 178 a year previously. During the year the London Branch was intimately associated with the annual Convention of the Institute and the Foundry Trade Exhibition, which were held in London in June, 1926, and sincere thanks were due to all who had so loyally contributed to the success of these undertakings.

During the year the Branch had held eight meetings, including the joint meeting with the London Local Section of the Institute of Metals. The members had paid two visits during the session, one to the London, Midland & Scottish Railway Company's works at Wolverton, and the other to the Midland Motor Cylinder Company's works at Birmingham. The annual dinner of the Branch, held in December, was the most successful one that could be remembered.

The Branch had been honoured during the year by the award of the Oliver Stubbs Gold Medal to one of its members, Mr. A. R. Bartlett. Additionally, Mr. M. J. Cooper had also been the recipient of a diploma for a Paper read before the Branch.

Financially, the Branch stood better than it had done for some time. The balance in hand on December 31, 1926, was £78 18s. 3d.

The representatives to the General Council were Messrs. Pierce, Slater and Hand, and, in view of the Branch membership having reached 200, the Branch was entitled to further representation.

Adoption of Hon. Secretary's Report.

On the motion of Mr. G. C. Pierce, seconded by Mr. W. B. Lake, the Hon. Secretary's report for the year 1926-27 was adopted.

Vote of Thanks to Mr. Sommerfield.

Mr. W. B. Lake proposed a vote of thanks to Mr. Sommerfield for the great work he had done during the past year. Not only had he carried out the ordinary duties of the Branch Hon. Secretary and Treasurer in a most exemplary way, but he had taken on his shoulders the whole burden of the Convention arrangements, and had carried out the work in a manner of which the members of the Branch had every reason to be proud. Everybody at the Convention had expressed complete satisfaction with the arrangements, which were due entirely to Mr. Sommerfield's efforts.

Mr. Shillitoe, in seconding, made a passing reference to Mr. Sommerfield's recent election to the Council of the Urban District of Finchley, and expressed the hope that Mr. Sommerfield would still be able to devote his energies to the interests of the London Branch.

The vote of thanks was carried with enthusiasm.

The following officers were elected: *Branch-President*, Mr. W. B. Lake; *Vice-Presidents*, Mr. J. W. Gardom and Mr. A. F. Gibbs; *Hon. Secretary*, Mr. H. G. Sommerfield. *Councillors*, Messrs. Cree, Shillitoe, Clark, Dews, Wares, Hand, A. W. G. Bagshawe, Bartram, and H. A. Carrell. *Auditors*, Messrs. Bartlett and Dews. *Representatives to General Council*, Messrs. Slater, Hand, Bagshawe, and Pierce.

Vote of Thanks to Mr. Cleaver.

Mr. Sommerfield proposed that the best thanks of the members of the Branch be accorded Mr. Cleaver, for his services on the Council during many years.

The Branch-President, seconding, said it was only proper that such a vote of thanks be accorded. The remaining members of the Council, at the last Council meeting, had been unable to prevail upon Mr. Cleaver to continue his services, but he had been a Councillor for a great many years, and his services had been very useful indeed.

The vote of thanks was accorded with acclamation.

Welfare and Self-Help in the Iron and Steel Industry.

A FINE TEES-SIDE EXAMPLE.

The illuminated address recently presented by the workmen of Messrs. Head, Wrightson & Company, Limited, Teesdale Iron Works, Thornaby-on-Tees, to the chairman and directors of the Company, affords evidence of the excellent relationship subsisting between the Company and their employees. This address—which was drawn up solely by the workmen themselves without reference to any foreman or other official of the Company—came as a very pleasant surprise to the directors, who have given it a place of honour on the walls of the board room. Signed on behalf of the workmen by thirteen of their number, it runs as follows:—

"Gentlemen,—We, the workmen employed in your Teesdale Iron Works, desire to place on record our very sincere appreciation of your efforts during the past eight months to maintain regular employment in these Works in times and circumstances of unprecedented difficulty, and we take the opportunity of expressing our gratitude for the large measure of success which has attended your efforts. We also wish to assure you how deeply we value the consideration and assistance given in matters financial, and we on our part will do all in our power to foster this good-will and co-operation, which is essential for the maintenance and continuity of successful industry."

The concluding terms of this address are creditable not only to the good sense of the workmen, but go to show that the welfare work carried on for many years by the Company in the interests of their employees has been directed upon very sound lines. The principle of self-help has been the very mainspring of all the organisations for the well-being of the men which have been brought into operation at the Teesdale Iron Works. The Company generously co-operate in every scheme that is put forward where it is clearly demonstrable that the men are ready and willing to help themselves. In this way, not only is the

Fig. 1.—View in one of the Class Rooms.

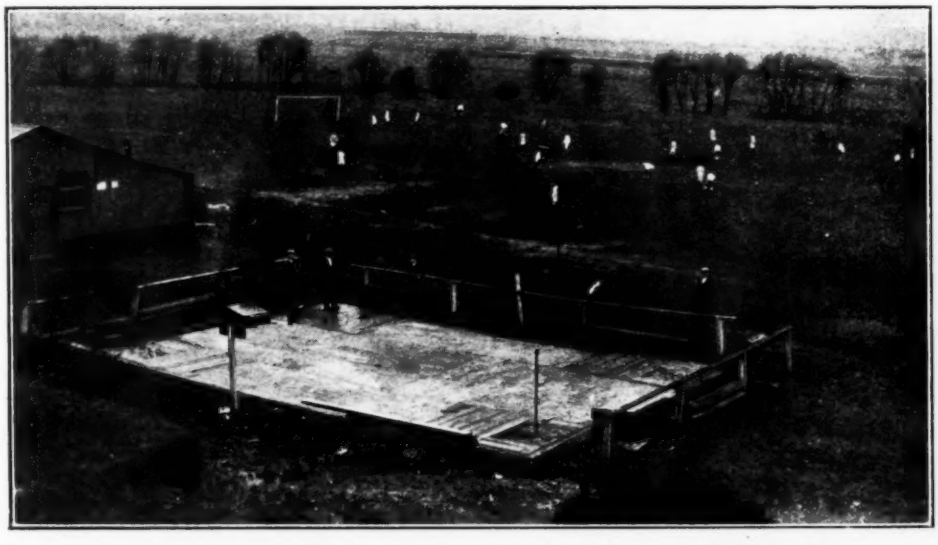

Fig. 2.—View of Football Ground with Quoit Court in Foreground.

sturdy independence of the men preserved, but their interest in every undertaking is greatly stimulated and developed.

A valuable illustration is afforded by the savings club, carried on under the ægis of the Welfare Committee. The men are free to deposit any weekly sum they choose, and can withdraw their money at any time for holidays, or any other purpose, but they receive no interest as individuals. The Company, however, contribute a sum equivalent to 10 per cent. on the gross annual contributions and this is carried to a benevolent fund, which is administered with the utmost care by the men's own representatives on the Welfare Committee. The result is that, while every deserving case is judiciously helped, a considerable sum has now been accumulated, and year by year is being increased. This is invested in gilt-edged securities, and is placed in the care of trustees, so that as time goes on the Welfare Committee will have a very substantial fund at their disposal for the assistance of workmen in sickness or any other adversity. This system has much to commend it as compared with the payment of a small rate of interest to the individual workmen. The Company's generous contribution is keenly appreciated, and the fund jealously guarded from any claims that will not bear strict examination.

The Welfare Committee consists of representatives from each department of the Works—iron and steel foundries, constructional, bridge-building, machine shops, and other departments, with the Works manager, Mr. G. E. Gore, as the *ex officio* chairman. While all trade union and other controversial questions are strictly barred, the Committee freely discuss all matters relating to Works conditions affecting the safety, health, and general well-being of the men.

With regard to recreation, the Company have placed at the disposal of the Committee about eight acres of land, very pleasantly situated, overlooking the Stockton racecourse, and this land has been developed for various pastimes, largely by the efforts of the men themselves. The Company have supplied materials wherever they have been required, and where necessary they have also paid for skilled labour. The result is that the men now have in their possession a good football and cricket ground, four tennis courts, two quoit grounds, and an admirable 18-hole miniature golf course. There is also a stand and pavilion, the latter serving as a spacious hall for indoor amusements in wet weather. The work of development is steadily going on, so that in the course of a few years great improvements will be effected. There is a recreation committee, comprising three representatives from each department, which, with the help of sub-committees, maintains a very efficient oversight over all matters connected with outdoor pastimes. It may be mentioned that the intermediate football team, consisting of lads under 21 years of age, won the championship of the Tees-side Works League for 1926-7. The Company have provided silver challenge cups for inter-departmental competition in football and cricket. These are competed for on the "knock-out" principle by teams selected from the different departments of the Works and offices, and the competitions are productive of a keen and friendly rivalry.

But it is on the educational side, perhaps, that the efforts of the Company have been most conspicuously successful. For upwards of 25 years two classes have been held, each of which is divided into junior and senior sections. One of the classes deals with Engineering, and the other with the Bridge and Constructional section, and all apprentices must attend their respective classes, or, alternatively, attend classes in the town. The course of instruction extends over about four years, and the total average attendance in normal times amounts to about 175. The instructors are taken from among the foremen or the more able workmen, who are remunerated by the Company, who also offer prizes to the successful lads in each section. Prizes are also given by the directors themselves. It is a matter of great gratification to the directors of the Company that there are many men to-day holding responsible positions in all parts of the world who gratefully acknowledge that the foundation of their successful careers was laid in the classes organised at the Teesdale Iron Works. Mention should not be forgotten of the ambulance classes arranged from time to time, by means of which there are always twenty or thirty men employed at the Works who are thoroughly efficient in first-aid.

Finally, when the working days of the men are over, there is provision for their old age. Arrangements are in being under which the regular old-age pension is supplemented by the directors to the fullest extent possible, without incurring a reduction of the national payment. Needless to say, this is greatly appreciated.

In these days when so much effort is being put forth on Socialist platforms still further to embitter the relations between Capital and Labour, such examples of harmonious working between employers and employed as that afforded by Messrs. Head, Wrightson & Company, Limited, are extremely valuable. The welfare work of the Teesdale Iron Works is, no doubt, only an illustration of many similar organisations up and down the country, which serve to demonstrate to all men and women of goodwill the keen desire of the vast majority of employers to work on terms of the closest harmony and co-operation with their men.

Institute of British Foundrymen.

Annual Meeting of Birmingham Branch.

The annual meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen was held at the Engineers' Club, Waterloo Street, Birmingham, on Thursday, April 21. Mr. D H. Wood (Branch-President) occupied the chair.

The report of the Council stated that during the year 1926-27 the Branch had made steady progress. An outstanding event had been the formation of a Junior Section. A chairman, secretary, and committee had been appointed, and six meetings had been held. The number of members up to present moment was 26, which was likely to be increased considerably within the next few weeks. The section would undoubtedly grow, and by the commencement of the next session should be in a flourishing condition. It was satisfactory to note that the attendances at the meetings of the Junior Section had been exceptionally good—averaging 95 per cent.

The Branch itself had held ten meetings, and there had been four works' visits. The Council desired to put on record their appreciation of the facilities extended by the Austin Motor Company, Messrs. Bellis & Morcom, Limited, the Industrial Research Section of the Birmingham Gas Department, and the British Cast Iron Research Association in connection with the works' visits, whilst thanks were also due to the several gentlemen who had given Papers during the session.

All the meetings had been held in the Engineers' Club, where ample facilities were available for meeting under most comfortable conditions. The annual outing took place in July last, and although very poor support was given to the Council by the members, the outing was greatly enjoyed by those participating in the journey to Broadway. The annual dinner, held in January, was attended by some 70 members and visitors, and as it coincided with the date of the General Council meeting in Birmingham, the President, Vice-President, and Past Presidents of the Institute, as well as other members, were present. During the year the following increase in membership had been made:—One subscribing firm, six members, 17 associate members. There had been two transfers to the Branch, and two transfers from the Branch, two resignations, and nine removals under Rule 16, leaving a net gain of 12 members, which compared unfavourably with the 57 members gained during the previous year. Subscriptions not paid for 1925-26 amounted to £54 10s. There had hardly been time for subscriptions for the current year to be collected, but already £64 1s. was in hand.

Advantages of Foundry Control.

By Horace J. Young, F.I.C.

Scientific foundry control in the hands of an amateur is likely to be either disastrous or useless. It is one of those things where everything included under the term experience is essential to success.

It has been said that the novice is timed—that his fear limits his progress. The novice adds steel to cupola mixtures, much as he would cut up a sheep; the man of experience does it like a butcher: the former would talk about it; the latter would fail to find anything in it to talk about. The one would add anything from 5 to 95 per cent. and think little about it; the other would add a negligible amount, and feverishly examine his metal for wonderful properties or defects.

Again, let us suppose that a foundry desires to make marine cylinder-liners to give excellent and uniform service under superheated steam conditions. This is a simple casting of metal which any foundry could make, and which very few foundries can. Yet to attempt to *explain* how to mix the particular irons in stock and why they should be so mixed is a more difficult task than to do it. So much and no more steel; no more and no less than a certain amount of scrap; certain amounts of certain types of pig-iron. The whole must add up to a definite chemical composition, and in causing it to do so the amounts of each kind of raw material must not be altered radically. Why? The only answer to a foundryman is that scientific experience shows it to be so.

Having reached so far, the cupola finally decides the metal coming out of its spout. Therefore, unless the compounder has full knowledge of the cupola and control over it, he cannot, in the first place, calculate his charge so that it will "come out all right," nor, in the second place, be sure that the cupola will not take a hand in the game and "work differently."

"A Little Knowledge — "

An example of this kind of thing in amateur hands once came directly under the author's notice. He had been successful in producing a high-sulphur iron which was machinable, tenacious, uncuttable with a hack-saw, and possessed exceptional wearing properties when used for marine cylinder-liners for superheated steam. Some time later, the author heard about a series of cylinder-liners, all of which had cracked immediately the engine was started up. This important happening in the cast-iron world was worth following up. It came to light that another firm of founders had learned about the success of this high-sulphur iron and had tried to make it.

Controlling Raw Materials.

With an organised stockyard—and every stockyard should be organised—with a metallurgist experienced in foundry control, and with a competent foreman moulder, it is possible easily to do what can be done in no other manner, namely, to produce cast iron to any desired quality and composition, and to do so year in and year out, irrespective of the alterations which take place in the raw materials.

It is common knowledge that hardly two consignments of pig-iron are alike, the differences being greatest in the case of high-class irons. In another place the author has explained this by the fact that the cheaper irons, being so full of impurities, have little scope to alter much, whereas the better irons can, and do, vary to an extent which makes them not worth using unless the foundry is scientifically controlled.

Foundrymen generally appear to be under the impression that the more they pay for an iron the better it is for their purpose. The truth is almost the exact opposite. Cheap irons are fairly regular, and so are the castings made from them. Expensive irons, being more irregular, are hopeless for use in rule-of-thumb mixtures, and, if so used, cause the castings to be very variable in quality.

High-Priced Irons Must be Chemically Uniform.

The only justification for paying a high price is when every consignment delivered is exactly like the previous one, and the only proof is a complete analysis. The salesman who says that composition does not matter, and that the properties of his goods remain the same when the composition varies, is banking on his customer not understanding the subject. The necessity for constant composition prevails in every metal and alloy under the sun, and cast irons are no exception. Granted that some cold-blast or hot-blast or cupola-refined irons may have their particular properties, but, nevertheless, their compositions as well as their methods of manufacture must remain constant if the castings made from them are to give consistent results. These things are self-evident, but, nevertheless, foundrymen buy a large quantity of expensive pig-irons.

Recently the author came across some large castings which were obviously very poor iron. Inquiry at the foundry concerned proved that they were using no cheap irons. Actually, what happened was that the pig-irons were seldom twice alike, they were mixed by rule-of-thumb and were not weighed, and cupola-practice was practically non-existent—the cupola, being a docile beast, melted the iron in its own fashion and according to its mood from day to day.

Frequently authors assume wrongly that air-furnace iron can be made to a more accurate and constant composition than can the product from a cupola. The author has purchased many tons of air-furnace iron, and also investigated many castings made either in an air or an electric furnace. Some consignments of air-furnace iron have been as follows:—

Delivery Date.	Weight of Consignment.	No. of Pigs Analysed.	T.C. %	Si. %	Mn. %
	Tons.				
January ..	7½	5	2.6	1.5	2.9
February ..	5½	5	2.5	0.8	2.3
April ..	7½	7	2.6	0.9	2.2
May ..	5½	6	2.7	1.8	2.6
May ..	7	7	2.7	1.1	2.1
June ..	6¾	6	2.6	1.3	2.8
July ..	6¾	6	2.6	0.8	2.9
July ..	6¼	6	2.2	0.9	2.0
September	4¾	5	2.4	1.3	1.5
November	4¼	6	2.6	1.4	2.9

Therefore, between January and November—a matter of eleven months—there were ten consignments of this iron, and the variations were as follows:—Total carbon varied from 2.2 to 2.7 per cent.; the silicon, from 0.8 to 1.8 per cent.; and the manganese, from 1.5 to 2.9 per cent.

As a matter of history, this iron varied so much from what was wanted that the makers were asked if they could supply to any *constant* composition, no matter what it might be. The final result was that the author was compelled to make the required iron in a cupola where, under scientific control, it was possible to produce it time and time again with almost perfect accuracy so far as silicon and manganese were concerned, and within, say, 0.15 per cent. in total carbon.

Another instance, typical of the unreliability of iron made in air or electric furnaces, comes from a series of castings which the author had occasion to examine. All the castings were made from the same pattern, and were supposed to be of similar quality to withstand very strenuous service conditions.

	T.C. %	Si. %	Mn. %
One casting	2.4	1.8	1.2
Another casting ..	2.9	1.2	1.1
" " ..	2.6	1.7	1.0
" ..	2.5	1.5	1.2
" " ..	2.7	1.0	0.9
" " ..	2.5	1.7	1.3
" " ..	2.7	1.2	1.3
" " ..	2.4	1.7	1.2

It is seen that the above differences are indicative of one thing only, namely, lack of scientific control. Moreover, the differences are vital. In

* A Paper read before the Middlesbrough Branch of the Institute of British Foundrymen.

the case of the variable pig-iron, it is impossible to use it for rule-of-thumb mixtures without running great risks, whilst for scientific mixtures there is no reason to pay a high price for variable material. In the case of the variable castings, the variations are extremely serious. It is hopeless to use castings for important work where, in one casting, the carbon may be only 2.4 per cent. and in the next as much as 2.9 per cent.; or if the silicon in one may be 1.2 per cent. and in another 1.7 per cent.

The controlled cupola is proving to be one of the most accurate of all furnaces, and if those firms producing high-priced iron—in pig or castings—cannot do better, their business will be adversely affected as engineers become enlightened to the importance of the subject. In modern engineering, when users are asked to pay a high price the foundry should provide a staff and an equipment capable of producing the goods.

To sum up the situation, it is essential that foundries supplying engineers with important castings shall look upon the production of high-class castings as a moulder's job and of high-class and uniform metal as a metallurgist's job. Also, the greatest economy and best results can come only by scientific control, no matter what industry the foundry caters for.

The Economics Achieved.

Scientific control generally means saving money. The author knows of foundries consuming very different amounts of coke for making precisely the same class of castings—one may burn 10 and another as much as 16 per cent. Many use drying stoves, which are really coke consumers, and dry in spite of their construction and not because of it. An enormous number are purchasing expensive pig-irons, and obtaining no benefit whatsoever.

Without exception the best cast irons which the author has met in a long experience have been made from the cupola and from ordinary pig-irons, plus cupola-melted pig-iron, with no expensive electric- or air-furnace irons and no cold-blast irons. He has never met any commercial iron which could not be imitated from a cupola.

For many years the author has adhered to the contention that, given a certain pig-iron or a certain cast iron, constant composition is utterly essential if uniform physical properties are to be maintained. Very many of the apparent mysteries surrounding differences in quality of cylinder-liners, cold-rolls, and so on, are due solely to the fact that the metal is never precisely alike (metallurgically) in any two cases.

Science is the detection, the study, the collation, the understanding and the application of natural phenomena. When materials differ in composition as do those set out in an earlier part of this Paper, there can be no hope of uniformity when those metals are subjected to various tests. One may be more heat-resisting, or stronger in tensile or in bending or in impact, or better wearing, or harder, or more impervious to oil or gases, or have a lower coefficient of expansion, or better conductivity—in some way or another there must be a difference if the irons are different.

The Perlit Process.

Speaking upon the effect of composition, the author has been interested to note that all the new processes, dealing with the manufacture of cast iron, are based upon composition, in other words, the processes are ineffective unless the composition is known and standard. He has been asked to mention the Perlit process.

The Lanz-Perlit process is a matter of cooling the iron at a rate predetermined and suited to its composition, mass and thickness. That we never before applied this system in the manner invented by Diefenthaler is a matter for regret: many good inventions appear obvious after they are discovered. A low-silicon iron turns white or mottled when cast into a bar of or below a certain thickness; above that thickness it remains grey. A higher-silicon iron will go white at the same thickness (as did the low-silicon one) provided we cool it sufficiently quickly. We all know these things: denseners, chills, casting-thicknesses and so forth being familiar to us. In the Perlit process, however, the opposite results are obtained. Instead of the irons going white at certain thicknesses, the mould is heated to that temperature which will keep the metal grey; more than that, it is heated to a temperature which will keep the iron from being too grey, namely, it will be, to all intents and purposes, all-pearlitic.

Curiously enough, the Perlit process is useful in another manner, because, when required, the composition and the heat-treatment can be adjusted so that the centre of the iron is less grey than the outside parts (just as, in the ordinary way, the outside of an iron can be made harder than the inside). Under the right conditions this procedure produces internal chill, which is useful in certain cases.

Low-carbon irons, with the addition of silicon or other elements, when cooled in accordance with their compositions, offer possibilities of being made to meet almost any requirements. Non-rusting iron, "straight" malleable, iron of great strength, etc., are likely to evolve. Already they have given us non-growth iron and iron of splendid regularity in the largest as well as the smallest castings.

Those people who have studied the recent researches of Mr. J. W. Donaldson, B.Sc., A.I.C. (published in The Foundry Trade Journals of February 17 and 24, 1927), and of Mr. C. E. Pearson, B.Met. (published in the Carnegie Scholarship Memoirs of the the Iron and Steel Institute, Vol. XV, 1927), have found proofs that Perlit irons cut from actual castings, maintained, at elevated temperatures and at one and the same time, their strength, volume, hardness, structure, and composition, better than any other cast iron.

The author was the first, in this country, to work the Perlit process, and, to-day, results are proving that his belief in it was not unfounded. Of the hundreds of inventions concerning cast iron, this is the only one which has caused an awakening. Our foundry people, our pig-iron people, all "turned pearlitic," and claimed, in a most delightful fashion, to put so many per cent. of it into their products. The very pages of our foundry literature became preheated. Looking back, one sees that the same waking-up process happened in the case of all important innovations—steel ships, motor vehicles, turbines, high-speed steel, flying machines, motor ships. An upheaval occurs before a reformation; it is part of it.

Dirt and Castings.

Sheer, honest dirt leads to many faulty iron castings. The ironfoundryman, as distinct from him who works in brass or non-ferrous metals, has much to learn in this particular direction. He will cheerfully pour pounds of filth into a mould—one can see it going in—and just as cheerfully will he tell you that dirt never gets down the runner, or, if it does, that it rises to the top. Anyone who has had the task of inspecting machined castings knows the utter fallacy of the above assumptions. Dirt must not be allowed to go into a casting. Ashes, sand, blacking, fireclay, kish, slag, scum, all come under this type of thing—and the ironfoundryman appears to love them. Better skimming—which does *not* mean merely breaking up the scum so as to enable it to more easily pass down the runner—or no skimming at all provides a partial remedy. For large castings the new "kettle" ladle seems to be an advance.

Correcting a Habit.

A receiver in front of the cupola is invaluable to the production of homogeneous castings of uniform composition. Also, it enables the iron to free itself from dirt, slag and gases. Under these conditions the foundryman, however heart-breaking it may be to him, should refrain from putting his shovelful of blacking, sand, coke or ashes upon the metal. This is a bad habit which, like spitting on the footpath, is neither necessary nor conducive to cleanliness. In all metallurgy the outstanding trouble with ladle-fluxes (or "covers") is the difficulty of removing them before pouring, and, generally speaking, they do more harm than good.

Draw Holes.

Draw or shrink holes, together with gas cavities, are the cause of many wasters and of much patching and burning. Proper metal and

discreet chilling will eliminate some drawholes, but at times design must be changed. Porosity is associated with drawholes where the walls of a casting form a junction, or where a lump of metal is surrounded by sand which gets overheated. Some holes are really "sinkings" of the molten or semi-molten iron; in a small way these are caused by leaks at joints, and in a large one by gas pockets, which disappear too late in the solidifying period. This kind of thing is seen sometimes in a flange, and the phenomenon may go side by side with cold-shuts.

Other Defects.

Damp moulds, inequalities in the sand, and poor venting are common faults. Foundry sand is insufficiently porous to permit of the free passage of mould gases; if it were, the mould would collapse. Hence, the venting of dry-sand moulds is an artificial process to which more attention might be given, by the foundry foreman, than is often the case. Inequalities in the sand lead to local gas-holes, scabbing, and to defects elsewhere in the casting, as well as where the trouble arises.

Inefficient Chaplets.

Chaplets are a nuisance; it is time somebody invented one that would become part and parcel of the casting. As it is, the chaplet remains as a foreign body in the metal, and around it one may expect leaks, cracks, hard metal, and all manner of defects. A study of these areas under the microscope is very instructive.

Burning-on is Risky.

A "burn" repairs a casting so far as looks are concerned; in all other ways it is a defect only to be permitted when the part concerned is unimportant. Moreover, its effects cannot be predicted or ascertained—there is always a risk associated with it. The microscope proves that the "burned-on" metal is dissimilar to the remainder of the casting.

Views on Costing.

Foundry costing is a popular subject nowadays, but requires to be approached scientifically and carefully. More money can be spent upon a costing system than it will save. A system based upon the untechnical methods common to a commercial department has no practical value. The amount of coke, metal, labour, and moulding materials used last year, and the year before, and so on, are not what is required. What it should show is the daily or weekly cost of the metal at the cupola spout; and the cost of making any particular casting, and how it varies according to the moulder or moulders employed upon it. Also, it must indicate the total cost of a job after taking into account all wasters and all scrap returned to the cupola platform. The cost of drying needs recording separately—both fuel and labour.

Simplicity, speed in getting results, practicability, and lack of red tape are essential features. The smallest and the largest foundry find utmost value in a scientific costing system, and little or none in any other. Foundry costing is not a commercial balance sheet, but a record for the use of those managing the foundry.

A Note on Fillets.

By J. McLachlan.

There are foremen patternmakers who are obsessed with the idea that when a pattern leaves the shop it should be so perfect that nothing is left to the moulder, and they do not take into consideration the ultimate cost of the casting. Filleting a pattern, especially round awkward shapes on loose parts, is very expensive and slow, because the fillet has to be cut with gouges from the solid timber, and if the work is wanted quickly, or if only one or two castings have to be made, the moulder can generally do it with little trouble. Straight lengths, however, should be done by the patternmaker and also fillets on circular pieces, that can be turned on the lathe.

When the filleting is left to the moulder, it is not fair to him for them not to be clearly marked with a paint brush. Fillets are not always wanted, but they always strengthen a casting, and naturally, unless instructed otherwise, the moulder will rub off corners. The size of the fillets should be plainly marked on a pattern even when they are painted in. The question of whether fillets on patterns and coreboxes should be finished off in the pattern shop, or left to the moulder, cannot be answered off hand. It depends upon the number of castings required, as this determines to a great extent the labour cost in the pattern shop or the foundry, and also on whether the metal is thin, as weight is very important, as the moulder is not too particular about the size of fillets and usually makes them large.

Wood fillets are not as much seen in pattern shops now as they used to be, probably because of the introduction of wax and leather, but in many ways they are better than either of the latter. If they are well glued and panel pinned and afterwards painted or varnished they will not readily rise at the edges, and they are clean to work with, and regular. A stock of them should always be kept of different sizes, and in a pigeonhole cupboard to prevent the edges from getting broken. They ought to be machine-made, of course, and if a spindle machine is not available a "patternmaking" machine will do the work equally as well, or they may be bought in. The practice sometimes adopted when a straight fillet is required of getting the timber sufficiently thick and then reducing to a certain depth at a dimension saw is very wasteful of both time and material. The only occasions when this is permissible are when ribs are recessed into a pattern or corebox and have to be loose.

Handling Leather Fillets.

Leather fillets are invaluable in high-class work, and whether the patterns are for hand or machine moulding. For motor work, as hundreds of castings are usually made from one pattern, it pays to make an almost perfect job. Baywood is invariably used, and the smallest fillets are finished off, but as the metal may be less than ¼-in. thick, it is not wise to leave anything to chance—or the moulder. He has not the same opportunity of consulting a drawing as the patternmaker. There is a knack in fastening leather fillets. The glue should not be thick, and care should be taken that no glue gets on the face of the fillet or it is more troublesome to rub. The rubbing is sometimes done with the backs of carving gouges, but it is worth while having dumb-bell brass rubbers. If the rubber is dipped in hot water it softens the surface of the leather, and a nice job is made. The most awkward corners can be leather-filleted by breaking the fillet in two or three places and paring the underside so that it will lie nicely over the other and present an unbroken surface. Sometimes it is necessary to pare the underside of the fillet, if the angle it has to be pressed into is very obtuse.

Wax fillets are not generally very satisfactory. Considerable skill is necessary before a really good job can be obtained. The newer kind of wax fillets, which are made to the actual shape of the fillet, are a considerable improvement on the old-fashioned method of pressing in a string of wax with the rubber. The fault with the wax is that the rubber must be exactly the size, and if it is too hot, the wax runs. Perhaps the best way is to heat the rubber in boiling water. Practice does assist one in getting the necessary temperature.

It is not necessary to cut large fillets from solid timber. It may be that a pattern will never be wanted again after a few castings have been made, and if a few section pieces are screwed between the joining walls of metal, the moulder can quite easily make a good fillet by filling up between them with ashes and loam.

The British Drying & Heating Company, of 14, Waterloo Place, have purchased the British and Dominion rights for the exploitation of the Poumay System of Cupola Control. Already several British installations have been erected and are under experimental operation. The system has achieved important proportions in both France and Belgium.

Discussion on Mr. Gill's Paper on Blast Furnace Practice at Consett Iron Co., Ltd.

As set out in a footnote,* this Paper was presented during a recent visit to the Consett Iron Company by the Newcastle Branch of the Institute of British Foundrymen by invitation of the directorate.

There was an attendance of over 100, including about twenty ladies. The party was received by Mr. E. J. George, who accompanied the visitors round the works. The furnaces were in operation during the afternoon, and the visitors saw them being charged and tapped and the pig-beds being poured. After the power-house and blast furnaces had been inspected, the party was entertained to tea, and later a meeting was held at the offices of the company, when Mr. C. S. Gill (member), of Consett, and manager of the blast furnaces, read a Paper entitled "Blast Furnace Practice."

After the reading of Mr. Gill's Paper, Mr. V. Stobie proposed a vote of thanks to Mr. George and to the Company for the way in which their members had been received. Mr. W. J. Paulin seconded this proposal, it being carried with acclamation.

Mr. George replied, and said that on behalf of the Company, the staff and himself, and particularly on behalf of Mr. Gill and his assistant, Mr. Walker, he accepted with much pleasure the appreciation which had been voiced. Blast furnaces were not at all interesting when they were idle, and Mr. Gill had had what he might not have had, a successful tap. It was generally the case, as perhaps they knew, that when a demonstration was required, although at an ordinary time everything would work smoothly, something would go wrong.

Comparisons with Scotch Methods.

In opening the discussion, Mr. Stobie said that the most interesting thing that he had noticed in the Paper had been the output. A furnace 55 ft. high, and with a bosh of 10 ft. diameter, was giving 1,100 to 1,200 tons of iron in a week. He had been at some blast furnaces in Scotland a week or two before, but the output from a furnace of the same size, making Scotch hematite with coal fuel, had only given 65 tons per day. He had no doubt Mr. Gill could give him the reason for this difference. Regarding coke consumption, somewhere between 19 and 20 cwts. per ton of iron were used in a blast furnace, and he would like to know why the output was not greater. In a charcoal furnace, only 11 cwts. per ton were used. Another point was that in comparing the analyses given in the Paper for a good and a bad working furnace they would notice that in the first case the carbon dioxide was greater than in the second. Analyses from a charcoal furnace definitely confirmed that, and so they might get at the reason why charcoal gave better fuel figures. The higher carbon dioxide figures showed that the carbon had burnt to greater effect, and if they considered that a charcoal furnace, when it was working well, worked at a high carbon dioxide content in the gas, they would get some faint idea why it gave a lower fuel consumption than coke. Charcoal was used for clarifying sugar, from which it took out organic substances; did it take up by adsorption minute pieces of iron in a charcoal furnace?

Mr. Paulin quoted from the Paper the sentence, "The production of very high silicon iron necessitates an extremely hot furnace, with the result that the cost of production is considerably increased owing to the excessive coke consumption and reduction in output," and said engineers had a child-like faith in the virtues of cold-blast iron, and it was generally thought that it was the best, but in the present case it seemed that the positions were reversed.

Mr. Stobie said that he would like to mention that he had been told by one of the heads of a firm of iron manufacturers that when they were asked for cold-blast iron they used to melt the iron in a cupola, as they did not have a blast furnace, and then put it through a Bessemer. Of course, it was certainly "cold-blast" iron. Mr. Stobie also asked Mr. Gill what his opinion was on the subject of the use of dry blast furnaces. From what he had heard it was not used so much in the States as had been the case in earlier days, but when it was used a uniform working was obtained by lowering the moisture in the blast to a uniform quantity. An early method of taking the moisture out was by freezing, although to-day there were several methods which did not involve the same heavy capital outlay as the refrigerating method. One way was to dry the air over lime, but that caused difficulties, as the lime was troublesome to work with. In Germany calcium chloride had been used, but the drawback with it was that, although at first it improved the air, liquefying the degranulation of the surface through hydration and subsequent dehydration prevented the passage of the air through it. The works which he had been visiting in Scotland had expectations of saving 2s. per ton on pig-iron by using dry blast, and of increasing the output by 26 per cent.

Furnace Castings.

Mr. Paulin said that he had noticed that the castings used in connection with the blast furnace were made of hematite, and he supposed that that was because they had to withstand high temperatures. For instance, the pipe conducting the hot air to the furnace was red-hot, and he would be interested to know what the life of such a pipe was, for, of course, it would be at that temperature always, as the blast furnaces were working continually. When hematite was used for ordinary castings, however, it gave a rather open grain; what did Mr. Gill think was the solution of that problem? With regard to blast pressure, he had seen that some of the furnaces ran at 5 lbs. pressure per sq. in., whereas No. 8 ran at 13 to 15 lbs., which seemed excessive. In comparing the cupola with the blast furnace Mr. Gill had not given the diameter of the melting zone of the cupola, but he supposed it must have been about 40 in.

Mr. W. J. Molyneux said that he had also been very interested in the great difference between the pressure of No. 8 furnace and the other furnaces. He did not think it could be altogether due to the larger diameter of the furnace, which was more on the lines of a modern furnace. He would like to know what was the difference in the quality of the iron which Mr. Gill obtained from No. 8 furnace and that from the smaller furnaces. In his opinion, the iron from the smaller furnaces would be of better quality. Regarding cold-blast furnaces the iron obtained from them had been very satisfactory, and in certain classes of work cold-blast iron was an absolute necessity. Iron of a similar composition could be made in a hot blast furnace, but the resultant casting was not satisfactory or of a quality equal to that of a casting made from cold-blast iron.

Mr. Stobie, referring to Mr. Gill's remarks on the decomposition of carbon dioxide in the furnace, *i.e.*, "In the upper part of the furnace shaft a reaction takes place in which carbon dioxide is decomposed in the presence of the freshly reduced iron with the formation of carbon monoxide and free carbon. This carbon is deposited in the form of a very fine powder in the pores and upon the surface of the ore. When the iron sponge melts, it is in immediate contact with this carbon besides the carbon of the coke," said that he would like to know whether Mr. Gill considered that all the carbon which was found in the pig-iron was taken up through contact between the molten iron and the carbon. If a piece of cast iron and piece of wrought iron or low carbon steel were machined and the surfaces polished, and, after getting intimate contact, they were heated up to above 900 deg. C., it would be found that some carbon from the cast iron would migrate into the wrought iron, which would tend to show that the sponge could take up carbon direct from the furnace gases. One might almost

* A Paper read before the Newcastle Branch of the Institute of British Foundrymen during a visit to the Consett Works. The Author is their Blast Furnace manager.

state that if it were necessary to melt the iron sponge before it took up any carbon it would require a terrific temperature, which he doubted whether it would be possible to get in a blast furnace. Mr. Stobie drew attention to the quantity of labour which was employed in charging the furnaces. For instance, he had seen about four men on one furnace charging by hand, and he thought it was interesting that they did not use machinery, which he believed was even used in the district for charging a number of cupolas, which would have small charges compared with a blast-furnace charge.

Author's Reply.

Mr. C. S. Gill, replying to the discussion, said that he would answer Mr. Stobie's last question first. The reason that their furnaces were not machine-charged was that it involved a great capital outlay. What they had seen that afternoon was an old-fashioned blast-furnace plant, although No. 8 furnace was reasonably modern as regards its lines and dimensions and so on; the charging, however, had been done in the same way for many years. Mr. Stobie had raised the question of the difference of the output in Scotland as compared with that of England. As they probably knew, conditions in Scotland were totally different. They themselves (the Consett Iron Company) charged coke which was very suitable for blast-furnace operations. In Scotland they charged coal which, as it heated and settled, formed a plastic mass, and it was practically impossible to force the blast through it at the rate they did with a coke charge, which preserved its shape and allowed the blast to have a free passage. In the Scottish method the coal, after it had settled, offered resistance to the blast, and therefore the output was low. Another point which Mr. Stobie had mentioned had been why a larger quantity of coke was used for a coke furnace than charcoal for a charcoal furnace. The conditions were different in a charcoal furnace, and the nearest they could get down to the quantities of charcoal used in a charcoal furnace was in No. 8 furnace, where they used 17 cwts. of coke per ton of pig. There was very much less sulphur in a charcoal furnace than in a coke one, and sulphur was an element which took much eliminating. It needed a considerable addition of lime, which necessitated a greater heat to decompose it and to get the sulphur and lime united, and also to raise the slag to a temperature when it would flow out. In charcoal blast-furnace practice the slag was highly siliceous and had a low melting point. An addition of 1 per cent. of ash in the fuel made a great difference in the amount of fuel required to run a furnace, and each 1 per cent. addition of ash meant also 0.42 to 0.46 cwt. addition to the coke consumption. The difference between coke with an 8 per cent. ash content and coké with a 10 per cent. ash content was about 0.8 to 0.9 cwt. of coke per ton of pig produced. Charcoal with a low ash content had a great advantage over coke in that respect, also the type of iron ore used was purer. He did not consider that the charcoal absorbed the iron at all, if anything the iron absorbed the charcoal. As regards the question concerning dry blast and why it was not more universally used, Mr. Gill thought it was beneficial in that it tended to give uniformity of working. In a blast furnace weather conditions caused large differences in working. On a cold, frosty day, when there was little moisture in the air, a good slag was obtained, whereas on a foggy day the slag was thinner, that being due to the amount of water pumped into the furnace with the air.

He thought the majority of the carbon absorption was from the solid carbon, but one cannot be too definite, as it was established that absorption of carbon from gas did take place. He had had an instance of that at Thornaby, where the pipe which conveyed the gas had been made of steel. There had been a stoppage in the pipe, and they had been forced to stop the furnace and look into the dust catcher to find the cause. They found that the pipe had dropped off and blocked the outlet of the gas; upon examination they had discovered that the pipe had absorbed carbon to such an extent that it could be broken with a hammer.

With regard to cold-blast iron, he did not think its advantages were so apparent as they had been considered to be some years ago, but he agreed that certain types of castings had to be made from cold blast iron. He thought it would be essential when a low total carbon and silicon were necessary; it would be essential also when a chilled surface with a very close grain and high strength were needed. A low-silicon and total-carbon content with a close grain could, of course, be obtained by using another mixture and without the high cost of a cold-blast iron. He had been asked why they made their cast-iron castings from hematite; the chief reason was that they manufactured it. The blast pipes which they had seen red-hot were subject to that heat all the time and they lasted a long period, sometimes being broken by careless handling or by the slag getting back into the tuyeres and thus blocking them. They were made in their own foundry of hematite iron, which gave a strong casting. If strength was not the main requirement, however, hematite iron was not necessary; if a very fluid casting was demanded, then a high-phosphorus iron was used, that being the case for thin pipes and castings of a like nature. A strong iron which was also fluid was one which corresponded to a phosphorus content of about 0.5 per cent. The pressure of the blast depended purely upon the volume forced through the furnace. In the case of No. 8 furnace, there was a considerable column of material 60 to 63 ft. high. Into that column the blast was forced as quickly as possible, and it only took two or three seconds for it to go through and come out as gas. The reason for the blast pressure being higher in No. 8 furnace than in the other furnaces was because the column in these latter was only about 40 ft. high, and therefore the blast was forced through more quickly. If the furnace became sticky the material at the bottom was burnt up and an open space formed, and when the material at the top was forced down it slipped and the iron was chilled. It was very difficult to answer the question concerning the difference in quality of the irons made by No. 8 furnace and that made by the smaller furnaces. No. 8 furnace made a different type of iron, one of a lower silicon content, say, about 1 to 1.5 per cent., and of a low sulphur content also. The amount of iron made did not weaken the iron; on the other hand, he thought that No. 8 furnace made the stronger iron, and that made in the small furnaces had a coarser fracture.

Analogy with Steel Manufacture.

Mr. Stobie reminded Mr. Gill of Mr. Paulin's question concerning the qualities of cold blast as against those of hot blast. He said that he wondered if any guidance could be obtained from steel practice. For instance, the most violent oxidation in steel-making took place in a basic Bessemer which gave the poorest strength of steel; next came the basic open-hearth, in which drastic oxidation took place, although not so drastic as that of the Bessemer, but which gave a better strength. The next quality was that of crucible steel, which had still less oxidation, and the best steel of all was made in an electric furnace, where the process was of a reducing nature. That pointed to the fact that as the violence of the oxidation varied so did the quality of the steel.

Mr. Gill said that he thought it was rather difficult to answer Mr. Stobie, as he did not know whether other steel-makers would support his (Mr. Stobie's) classification of the qualities of the steel. His opinion was that it was not so much the reducing atmosphere in the electric furnace as the type of steel made in it, *i.e.*, it was reserved for special grades. The same was the case with crucible steel, which was a very special type made in small quantities. He thought it was not entirely due to lack of oxidation. The real difference between cold and hot blast was that in cold blast the iron was low in total carbon and had a very close dense fracture which was essential to some castings, and if those qualifications were desired in hot-blast iron some different material had to be mixed with it.

Vocational and Technical Instruction in Relation to the Foundry Trade.*

By Arthur Soupart, Director of the State Industrial Museum and the Technical Schools, Morlanwelz.

Introduction.

In a lengthy Paper submitted to the Congress on the subject of Vocational and Technical Instruction in Relation to the Foundry Trade, M. Arthur Soupart, by way of showing the need for such instruction on a more extensive scale, began by surveying the present situation in the industry. While enormous scientific and technical progress had been achieved in most branches of manufacture during the past fifty years, it was undeniable, he thought, that the foundry trade—although the most ancient as an art—had not kept pace as it ought to have done, and that at the end of last century it did not occupy that place in the iron industry which it might properly have filled. Routine had been too powerful in the trade, and theoretical and technical elements had been wanting. During the last 25 years, however, and particularly since the war, a considerable change had taken place, and it might be truly said that the industry had recently shown a determination to make up for lost time.

This was the result of necessity. In modern industrial life the keenness of competition and the diffusion of the scientific spirit throughout every branch of human activity had made it imperative for every industry to perfect its methods if it did not wish to vegetate and ultimately disappear. In foundry work the requirements of castings in motor-car construction and in the electrical industries, the increased demand for steel castings and the extensive development in central heating, had very largely contributed to the progress made. The scientific spirit had penetrated into the modern foundry, bringing with it research laboratories and, in particular, a revolution in the methods of testing, not only the metal, but all the materials employed. The chemical study of pig-iron, cast steel, malleable cast iron, copper alloys, etc., had been greatly advanced and had resulted in the properties of these metals being very considerably improved. These and many other improvements had obviously served to alter ideas regarding the construction and equipment of foundries; general and particular principles aiming at a better organisation of the work and healthier conditions in the shops had now to be observed. A realisation of the progress already made and of the preponderating part now played by science in the industry was the determining factor in the minds of those who held that the labour employed in it should be more highly skilled, and that the training of those sections of the personnel who would in future be responsible for the application of new methods should be more methodical and scientific.

Empirical Standardisation.

The foundry trade required a knowledge of most of the operations involved in the construction of machinery. It was based upon three distinct arts —moulding, founding and engineering—and demanded perhaps more dexterity, care and judgment than any other branch of metallurgical work. The results depended largely on hand and head work, machinery playing a relatively small part, except in certain castings. They depended not only on the competence of the foundry manager as regards the selection of the materials to be used, but also on that of the founder as regards the arrangement of these materials and the operation of casting, as well as the competence of the moulder in the preparation of the moulds. It was incontestable that foundry work presented increasing difficulties in regard to the casting and moulding of machine castings, malleable or semi-steel, and steel, bronze, aluminium and other castings. To solve these difficulties the workers must be given the scientific training in which they were lacking. Their work was much more difficult than that of the machinist; neither the liquid metal, the moulds nor the cores were standardised, and special qualifications were therefore necessary to secure uniformity in the product. The work was essentially one of observation, and the worker must be intelligent and capable of observing, judging and reasoning. To succeed in the industry it was therefore indispensable to possess a basis of certain innate qualities, together with other qualities capable of being developed by systematic instruction. In the first place, there must be adequate health and strength, quickness of observation and manual dexterity. It was therefore necessary to interest in the trade young men, physically suitable, who are already well fitted for it by general education, so that the number of recruits might be increased and their quality improved. There was no reason why foundry work should not attract men of the same educational status as draughtsmen, electricians, machinists, patternmakers, etc. Such men would advance more rapidly and, provided they acquired other fundamental qualities, they would make good foremen and foundry managers later on.

Recruiting Trained Labour.

The methodical, systematic and intensive organisation of apprenticeship was of the utmost importance if an adequate supply of suitable labour was to be maintained. Technical instruction in foundry work had been greatly neglected, and it must be given its proper place without delay. In the development of an apprenticeship system with an adequate output of skilled workers the difficulty was both quantitative and qualitative. In certain districts of Belgium the ranks of foundry workers were recruited almost automatically, but this was by no means the case generally. Figures published by the Syndicat des Fondeurs de France showed that to maintain the necessary quantity of labour each foundry must take annually apprentices to the extent of 5 to 7 per cent. of the workmen and labourers employed, or about 10 per cent. taking account of losses during apprenticeship. These figures might be taken as approximating also to the needs of the industry in Belgium. Atavism could not be relied on in foundry work as in certain other occupations; the foundry worker no longer wished to see his son a moulder. Yet foundry work was now much more hygienic than formerly, and its dangers were less than in many other engineering trades. It should be pointed out to those who preferred certain branches of engineering that foundry work also involved engineering, that the industry was not overcrowded, and that wages were as high as in other branches, if not higher. The old system of apprenticeship, however, whereby the apprentice helped the experienced workman and was thus enabled gradually to assimilate the principles and practices of the trade, no longer seemed practicable or capable of producing fruitful results. This system of training had been found to be too empirical. Methods of working had been modified: the factors of time, movement, muscular effort, etc.—in short, everything affecting output—had now assumed enormous importance. The trade consciousness was no longer what it had been, and consequently apprenticeship by example would only give insignificant, if not negative, results, devoid of the spirit of discipline and vitiated by an excess of empiricism. The future of the foundry industry required that this serious state of things should be energetically remedied. By means of systematic organisation it was possible to raise the technical equipment of the trade and make it more interesting and especially more attractive, while at the same time improving the trade consciousness.

Supply of Executive Officers.

The supply of competent foremen and managers was intimately related to that of labour. In most

* A Paper, read before the Brussels Congress of the Belgian Foundrymen's Association. M. Paul Ropsy presiding.

cases foundry foremen had trained themselves and had been chosen from among the older intelligent moulders who, by the force of circumstances, had learned to work a cupola. While they showed competence, initiative and decision, their general training and technical and scientific equipment—the value of which must not be underestimated—was merely the result of their own experience. In view of the enormous development of the industry, however, it was being found every day that such training and equipment were inadequate; they were even the cause of reduced output and, in certain cases, an obstacle to the introduction of new and improved methods. While in many branches of engineering it was the exception for foremen and shop managers not to hold the diploma of a technical college, the case was different in regard to the responsible agents in the foundry. The workman must be guided before and during the work, and if he were properly supported, the speed and the result of the work could not but be improved. If, therefore, it was desired to find in the ranks of the workmen men capable of management—and in this there were many advantages—it was necessary to pay the most serious attention to training as well and as completely as possible those who would later be called upon to become the direct collaborators of the leaders of the industry.

Co-operative Training.

The course and methods of instruction must differ according as the object might be the training of competent workmen or the production of competent foundry managers. But the system must be democratic and well graduated, so that the young workman, if competent, should be able to reach the highest positions. As regards technical schools versus the foundry as the actual place of instruction, it was agreed by those individuals and bodies most competent to judge that, unless well equipped schools for foundry work were available, with courses of regular and fairly numerous castings, etc.—which would involve enormous cost—apprentices could be trained thoroughly only in the foundry itself, in its atmosphere and during its regular working. But if apprentices were to be trained in the school shop of the foundry the training must be subject to rigid conditions. The atmosphere, system and discipline of the school shop must be those of the technical school. Here the chief difficulty would be in finding a suitable instructor for apprentices in works employing only 40 or 50 workmen, but this could be overcome, as in other industries, by co-operation between several foundries. If apprenticeship were to be served at a technical school it was essential that the system and working equipment should approximate as closely as possible to actual practice, otherwise the vocational instruction acquired would prove quite inadequate. But in order to learn it was necessary also to produce, and apprenticeship must be associated with the production of castings of practical utility, to which time and costing standards should be applied. At the end of the second or the beginning of the third year the apprentices might be distributed among the foundry staff, while still remaining the object of special supervision.

Belgian Technical High School Advocated.

It was very desirable that the course of instruction given should not be too full and comprehensive. Nor should it be merely a bare outline. Experience showed that a programme which was irreproachable in its completeness might mean bad instruction, while a more restricted programme, accompanied by judicious interpretation, was capable of giving the best results. Practical work should be carried out simultaneously with the technical instruction given. By means of methodical and graduated exercises the apprentice should be systematically initiated into the life of the foundry, the handling of the tools, the materials used, the processes employed, the different kinds of castings, etc., etc.

The success of the scheme, M. Soupart admitted, must depend on the combined action of the public authorities, the foundry trade and the labour organisations. Instructional institutions should be established in sufficient number, or reorganised in view of the relations which ought to exist between them, so as to permit of progressive instruction leading to the stage of higher instruction. Apprenticeship, either at the foundry or the technical school, would form the basis of the scheme. In foundries with 50 or more workers there would be an apprentices' school with a special instructor, to admit young men as apprentices to the extent of 10 per cent. of the staff. This would not mean any considerable pecuniary sacrifice on the part of the manufacturer. In conjunction with this foundry apprenticeship there would at first be elementary courses for young working moulders, while evening and Sunday vocational improvement courses would afterwards be established with the aid of the industry, as certain demonstrations could be carried out advantageously only in the foundry. The general training, scientific and technological courses would be given in the evenings or on Sundays at the technical school. The foundries, however, should be freely open for the purposes of the technological course, and visits to works should be widely organised. The ensuing stage, that of the secondary technical school, would be destined to train the intermediate research staff and the foundry managers. In Belgium, however, to crown all this there was need for an Ecole Supérieure de Fonderie, like that of France, which would be open to educated young men who had already acquired a certain knowledge of foundry work. Such an institution would be fitly completed by a research and testing laboratory, to be established with the co-operation of the foundrymen of Belgium, to which they would send their products.

Propaganda Proposed.

Systematic and intelligent propaganda was also necessary, however, if recruits of the right kind were to be attracted to the trade in sufficient numbers. This should include the organisation of visits to foundries by the pupils of the higher years in primary schools: lectures, illustrated with films, in industrial centres: the issue of posters at the end of the school year, appealing to parents and their sons considering a career; the collaboration of trade unions in support of apprenticeship and attendance at the instructional courses; the giving of prizes for competence, to be distributed with suitable ceremony and publicity; the organisation of trade competitions and exhibitions; the institution of bursaries for the encouragement of technical study; the offer of advantages as regards wages and otherwise compared with the other metal industries. From first to last, however, one idea should predominate throughout the scheme—the inculcation of habits of order, regularity and precision, contributing to the formation of methods of work which were indispensable to the progress of the industry.

Notes from France.

A new bath-tub foundry is being erected at Beaucaire (Gard). It is geographically well situated to supply the South of France.

Last Thursday, before the Association Technique de Fonderie, Monsieur M. Fourment read a Paper on "The Present Situation of Electric Furnace Melting in Relation to Foundry Practice."

Trade conditions amongst the jobbing foundries are picking up, and in the Ardennes employment is improving. Buyers are counting on lower pig-iron prices next month. The malleable foundries are somewhat slack on account of a falling off of orders from the motor industry.

A Black Spot.

We regret that owing to the unfortunate interleaving of a piece of metal between the copper and wooden portions of a printing block, a fracture of a test piece used to illustrate an advertisement issued by Messrs. British Pigirons, Limited, and included in our last issue, gave the impression of the presence of an impurity or blowhole. We have had the opportunity of inspecting the original photograph, and can assure our readers that the fracture was in every way perfect.

XUM

Oil Sand Cores and Moulds.

Views of London Foundrymen.

At the last meeting of the London Branch of the Institute of British Foundrymen, Mr. Walter West, of Leyland Motors, Limited, gave an address on "Oil Sand Cores and Moulds," which has previously been printed in our columns. It was illustrated by an excellent film and many interesting lantern slides.

Mr. Shaw, the Branch President, in opening the discussion, remarked upon the excellence of the green bond strength of the cores as shown in the film. He was particularly interested in the nature of the mixture, and also what was done with the spent sand after casting. With regard to the making of Trojan pistons—what was the exact function of the oil-sand ring which formed the edge of the mould—because in view of the fact that the oil-sand centre core had its own print in which to sit, there seems to be something lacking in the picture to show the necessity for the ring core.

Several Mixtures Used.

Mr. West said, in reply, that up in Lancashire they had plenty of room in which to dispose of their spent sand, and it was not necessary for them to utilise any of it, for they were next door to Southport, and were able to get sand into the works at something just over five shillings a ton, so that any attempt to utilise the spent sand would be rather futile. But it would be possible to break up some of the oil sand and use it over again, and "necessity became the mother of invention." Leyland was quite a small village, so he was leaving it to the next generation to fill up all the spaces with spent sand! With regard to the mixtures, they had something like eight of these for different classes of work, and if he were to give them a list of them he doubted whether it would be of any use, for it was not only the mixture itself but the appropriate way in which each classification was used that was important. But if anyone who was sufficiently interested in the using of oil sand would write to the Leyland works they would be only too pleased to show the mixtures in use and the way they used them, and to give every possible help. (Applause.)

With regard to the pistons, the cinematograph film might have shown more than it did. When this was put before the camera it was realised that it could have done with some further exemplification. But the two small gadgets which the moulder dropped into the mould were, in the one case, a cardboard disc in order to get the thickness of the crown, and in the other a ring, which just ensured that the end of the core was concentric with the outside. If there was any variation in core or thickness of crown then in the core print it would project, and at once be detected. When the box was lifted out the ring and thickness gauges were left. The middle part was set upon a plain bottom part, and the thickness and concentricity of the casting was assured.

Standard Baking Temperature.

Mr. G. C. Pierce stated that there were proprietary core mixtures on the market, which would yield a core sand which in the green state could be picked up by the hand—did the lecturers think that the sand mixtures as used by them would give the same green bond strength?

If so, would Mr. West give them such a mixture so that those who could not take advantage of the offer to visit the works at Leyland could apply it in their own foundries? This would be greatly appreciated by many. Further, as to the temperature of drying the cores, would the temperature of 250 deg. C. apply to all core-sand mixtures where linseed oil is used as a base or does the temperature alter according to the additions in the mixture?

Mr. West said, in reply, that he rather accounted himself a connoisseur on oils and oil mixtures, proprietary and otherwise, because he kept a small sample of every one he could get hold of for reference, but he had never used any proprietary mixture yet that had given him in the green state as great a strength as their own mixture. As to actually picking a core up, he did not quite know about that, but the oil sand in the green state was quite soft, and if there was any weight of sand in the core one could not actually pick it up by the back and put it down again.

Reinforcing Irons Largely Eliminated.

Mr. Pierce asked, supposing a three-way pipe were being made, and the core was reinforced by a three-way iron, would it stand by itself, and could it be transferred to another plate merely picking it up by the hand?

Mr. West replied that he did not use any iron nor any wires unless it was something like a right-angled bend. He thought that if one had an iron in the core one could do as Mr. Pierce suggested. Of course, the introduction of an iron into the core helped, and if one was able to pick it up by itself this was due not so much to the core mixture as to the iron. He had supposed Mr. Pierce to be referring to the core without any irons or wires. Under these conditions he never hoped to get a mixture that could stand up to such requirements.

With regard to the mixtures, as those present would know from work done at Leyland, they had not only got down to the rock bottom percentages of the various elements in the mixtures, but had definitely decided upon the treatment of it under their own conditions. But as other people had tried a given mixture, and had thrown it up because they could not make it successfully, it was decided that if any were interested they should be invited to Leyland to see the mixture actually being made and used under the conditions which they at Leyland understood. Foundries differed just as much as faces differed, and what appertained in one foundry did not hold good in another. But as long as good linseed oil was used it might be taken that the baking temperature given would hold good, and it surprised them when they raised the temperature to 250 deg. C. to get the results they were obtaining at present.

With regard to the spent sand, unfortunately for those in London there was no source of supply very near. If they bought sea sand, and got it from Southport, it was as well to stipulate that it should come from the Birkdale end, and not from the Southport end. The latter contained quite a lot of carbonaceous matter, and sea shells. Some preferred to use it wet and some dry, though he personally insisted that all the sand should be dried, so that a start was made on a common basis.

A Member remarked that in one of the pictures a man was shown pulling out a plug and ramming in some black sand. What was the purpose of that?

Mr. West: To keep the hole from distortion.

The Member: It might save them doing that every time if there was a casting put in.

Mr. Aston (Leyland): I have done that in many things, but the core-makers prefer the packing sand. In other classes of casting I have made a replica of the part that would pull out, but the moulders prefer to use the sand.

Oven Design.

A Member said that in their own experience with oil sand they had found it necessary to increase the inlets to the oven for extra air. Did this agree with the practice at Leyland?

Mr. West said that instead of putting the holes in the actual oven itself they had excess air port-holes, which led into an air chamber around the firebox where the air could go in and meet the products of combustion just at the beginning of the flue. That was a thing which had been found very advantageous, to let the air come as secondary air to mix with the products of combustion. Without this they would not get the

good results they did. It was a very important point in making oil-sand cores.

Rate of Drying.

Mr. Gardom remarked that the film picture gave an excellent idea of the strength of the cores and moulds in the green condition, but was it not found that during the period of standing and drying that sagging of the mass took place. As the lecturer had specified a definite temperature at which the best drying could be obtained, does this refer to the temperature of the oven itself? And, further, is there any advantage to be gained by quick-drying over slow-drying? Has it been found that cores baked at this temperature have any tendency to become soft when put into a green-sand mould.

Reference had been made to the Iodine value of any oil used for core making. Would Mr. West advocate that foundrymen buy their oils according to this factor?

Rosin Increases Green Bond Strength

Mr. West, in reply, said that as it happened in connection with the making of Leyland Lion cylinders and heads, the greatest height was something like 9 in., but no sagging whatever was experienced if one had the correct mixture, and here he would say that concerning the addition of rosin—he was careful to emphasise rosin, not resin—this actually increased the green strength of the core. Mixtures had been tried with oil and dextrine or molasses and various other substances, but up to the present moment nothing had been found better than the addition of rosin to give the greatest green strength for the core. Concerning the question of sagging, the Trojan piston core was about one of the most difficult things they made in the way of standing up, but there, again, they had no trouble from sagging, and it was only necessary under the two bosses on either side which were intended to give the internal bosses of the piston just to place a piece of curved metal to hold the structure during the drying. No matter how long they stood they were hardening, and it would be well understood how that was the case because the linseed oil itself was picking up oxygen. The only effect of putting it in the core oven was to accelerate the setting of the linseed oil.

The temperature of 250 deg. C. was the temperature of the oven, and it depended upon the design of the oven whether there was an even temperature. If they had the old type of stove with the open fire at one end in which the products of combustion were allowed to go where they liked, then one got uneven temperatures, but to tackle the question of oil sand as it should be tackled, required the laying down of an oven which was designed to give an even temperature. The only drop in temperature was during the opening and closing of the doors to take the cores in or out. They had one pyrometer when they first started, just to get the people on the job accustomed to the temperature, but it was remarkable how soon these men who were handing the stoves every day could tell the state of affairs from the colour of the core and the feel of it, as well as by any pyrometer. There was a distinct difference in the colour, when the core had not been taken up to the desired temperature.

Drying Desiderata.

The question of quick-drying depended upon the mixture. If one was plotting a curve showing the effect of heating a core made from emulsion it would be found that just above 100 deg. there was a sag in the curve, and then when the water had evaporated the temperature of the core would jump up. No moisture or water was added to the mixture shown. If the oil-sand cores were not taken up to a temperature of 250 deg. one got a green colour on the core which if it was left in the green sand mould sufficiently long would strike back. On the other hand once the core mixture had been subjected to this temperature it would not strike back, and he could himself quite see why from the theoretical point of view it should not strike back, the reason being that the chemical constitution had been altered so that it was not susceptible to the absorption of moisture. That was why it had been found that this temperature was the best of any they had used. He wanted those present to understand that in bringing up the subject of iodine values it was not that he would advocate that foundrymen should buy their core oils on the iodine value, but the mention of iodine values was to show on the theoretical side how these things acted. If one had to look down the list of various oils it would be found that linseed oil led the table so far as iodine value was concerned, and that coincided with the fact that it was the best drying oil of the whole series.

Colour and Function of Temperature.

In reply to Mr. Dews, who asked whether the colour of the cores was the function of the temperature or the time of drying, and whether Mr. West varied his oil mixtures or his drying period or the temperature to get the core to stand up to the higher temperatures of steel casting, Mr. West further said that the colour of the core was entirely a function of the temperature. The men who are handling the cores know to a nicety from the colour how to regulate the temperature. Some cores would take twenty minutes, some an hour, but for the heaviest cores, weighing 4 cwt. or so, no longer time was required than one and a half hours. He also mentioned that at Leyland they were dealing with 90 tons of oil sand a week, and for the sake of convenience they had mixtures which would answer both for iron and steel casting.

He had not thought of suggesting that a conveyor system could not be used (this in reply to a further question by Mr. Gardom), and as a matter of fact he thought it was the ideal to be wished for. But he could not quite agree that a larger core would dry in the same time as a smaller one, though one might get the outside dry, yet for the sake of lifting one must have the inside reasonably hard so that the heavier core could be handled. On that account the larger core had to be left in for a longer time than the small core. He would like to see the conveyor system working.

Vote of Thanks.

Mr. Pierce asked the whole of those present to join in a hearty round of acclamation to Mr. West, and to include in the compliment, his friend Mr. Aston, who had also come down from Leyland to assist in the demonstration.

The vote of thanks was heartily accorded, and

Mr. West, in response, said that on behalf of the Leyland Company, who had kindly enabled them to come down and bring the samples, and who had made it possible to get up the film, which had been projected, and to show it to the company, and on behalf of his colleague, Mr. Aston, he had to thank them for the interest they had shown and the vote of thanks which they had carried. In reply to a final remark of the President, he added that in some cores it was advisable to put wire, it depended upon the design.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Consett Blast Furnace.

To the Editor of The Foundry Trade Journal.

Sir,—In looking through the article "Blast-Furnace Practice at Consett Iron Company, Limited" in your issue April 21, 1927, at the foot of column 2, page 332, I noticed the words "dioxide" and "monoxide" had been crossed. The sentence should read: "Carbon monoxide is decomposed in the presence of the freshly reduced iron with the formation of carbon dioxide and free carbon."

I regret this obvious error was not detected before you received your copy of the Paper.

Yours, etc.,

Chas. S. Gill.

Ceramic Society.—The Ceramic Society is holding its spring meeting in Czecho-Slovakia during the period April 30 to May 16.

Trade Talk.

Works for the manufacture of scrap bars have been started at Willesden by the Iron & Horseshoe Company, Limited.

The shareholders of the British Metallic Roll Company, Limited, have decided to wind up the company voluntarily. Mr. A. Jackson, Hope Mills, Pollard Street, Manchester, has been appointed liquidator..

Messrs. A. Learoyd and A. F. Learoyd, Bridge Works, Heatherley Street, Clapton, metal merchants, trading under the style of A. Learoyd & Son, have dissolved partnership. The business will be carried on in the future by Mr. A. F. Learoyd.

Thos. W. Ward, Limited, Sheffield, who 18 months ago acquired the granite quarries at De Lank, Cornwall, have just secured from Sir Robert McAlpine & Sons (London), Limited, an order to supply the whole of the granite for the new dock improvements at Tilbury.

Within the last few days the Electric Furnace Company, Limited, of 17, Victoria Street, London, S.W.1, have received orders for six Ajax-Wyatt brass melting furnaces, each of 600 lbs. capacity, for a French firm, and also a 100 kilowatt resistance furnace for annealing aluminium sheet in Scotland.

For the year ended December 31, 1926, each one of the numerous London lorry and van drivers in the employ of Allen-Liversidge, Limited, the well-known manufacturers of welding and lighting equipment, has been awarded the diploma of the London Safety First Council for having been free from accidents in the Greater London area.

Bolckow, Vaughan & Company, Limited, have opened a district office at Hallgate Chambers, Doncaster, which will be known as the South Yorkshire District office. The office will be in charge of Mr. P. Leon Hardy, who will act as representative of Bolckow, Vaughan & Company, Limited, in the South Yorkshire, North Derbyshire and Lincolnshire districts.

Alexander, Fergusson & Company, Limited, 50, Ruchill Street, Maryhill, Glasgow; Johnson's Iron and Steel Company, Limited, Hall End Iron Works, West Bromwich; the Harvey Engineering Company, Limited, 224, West Street, Glasgow; and Michael & Joseph Wing, Limited, Jericho Works, Holme Lane, Hillsborough, Sheffield, have joined the Federation of British Industries.

The Polish Broadcasting Company (Poleskie Radio) have just placed a contract for a 10-kw. broadcasting station to be erected at Katowice. It is interesting to note that this equipment will be manufactured in London at the works of the Standard Telephones and Cables, Limited. This follows on contracts for broadcasting equipments for the Irish Free State, Denmark, Japan and New Zealand.

Company Reports.

Monk Bridge Iron & Steel Company, Limited.—Loss for year, £24,682; debit brought in, total adverse balance, £145,745.

Bede Metal & Chemical Company, Limited.—Interest on bank overdraft, £2,466; loss for year, £4,908; debit balance brought forward, £51,535; debit of profit and loss account, £56,504.

Hopkinsons, Limited.—Profits, £72,288; profits earned during period prior to incorporation, £11,347, deducted and transferred to capital reserve account; final dividend, 5 per cent. on ordinary shares, making 10 per cent. for year; carry forward, £12,225.

Newton, Chambers & Company, Limited. — Profit, £59,500; brought in, £60,957; total, £120,457; interim dividends, 2½ per cent., tax free, on preference and ordinary shares; available balance, £105,134; final dividends, 7½ per cent., tax free, on both classes of shares, making 10 per cent. (net) for year; carried forward, £59,165.

Beyer, Peacock & Company, Limited.—Net profit, £11,197; depreciation reserve, £16,822; interest on debenture stock; transferred from reserve, £14,000; brought forward, £17,520; dividends on 5½ per cent. cumulative preference shares for three half-years to December 31, 1925, paid, also dividends for year 1926, thus clearing off all arrears; carried forward, £1,467.

Howard & Bullough, Limited. — Profits, £41,926; brought forward, £159,947; interim dividend paid for half year 6 per cent. per annum on preference; two quarterly dividends, 2½ per cent., making 5 per cent. on ordinary shares; debenture interest to March 31, 1927; disposable balance, £123,544; dividend 6 per cent. per annum, or 2 per cent. for four months to March 31, 1927, on preference shares, £5,000; ordinary dividend, 10 per cent. per annum, or 3½ per cent. for four months to March 31, 1927; carried forward, £76,878.

Obituary.

Dr. A. L. Simon, the eminent metallurgist, who had been a member of the Institution of Mining and Metallurgy for some 30 years, has died after a brief illness. Dr. Simon graduated at Zurich in 1883, and after several years' work at various laboratories in Europe joined in 1889 the staff of H. Eckstein & Company, in Johannesburg. Since 1898 Dr. Simon had practised as a consulting engineer in London.

Personal.

Mr. L. D. Wingate, general manager of Richardsons, Westgarth & Company, Limited, Hartlepool, has retired after 42 years' service with the company and its predecessors, T. Richardson & Sons. He has been the recipient of a presentation from the chief officials.

Mr. F. S. Thompson, Mr. J. A. Thompson and Mr. H. J. Thompson, directors of the firm of Thompson Bros., Bilston, Limited, have been presented by the employees each with a beautifully-engraved bronze tablet in appreciation of their kindness during many years of their connection with the firm.

Will.

Mr. Edward Woolley, J.P., of Blackburn Road, Accrington, ironfounder, who died on March 8, aged 80, left estate of the gross value of £13,108, with net personalty £13,062.

Patent Specifications.

The following list of Patent Specifications Accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

31,712. Thomas & Company, Limited, R., and Davies, T. F. Tinplate and sheet mill furnaces. December 16, 1925. 267,592.

32,256. Körber, G. Annealing-furnaces. December 21, 1925. 267,620.

33,008. Bracq, E. Furnaces for roasting ores. March 9, 1925. 248,711.

4,372. Thomas, D. J., and Vickery, J. L. Device for boshing tinplate and sheet-bar sections. February 16, 1926. 267,679.

4,776. Kuehnrich, P. R. Heat-treatment of alloy steels. February 19, 1926. 267,687.

8,535. Mullen, B. J. Machines for tapping blast-furnaces. March 29, 1926. 267,722.

9,089. Krupp Grusonwerk Akt.-Ges., F. Processes for working-up ores containing volatilisable metals. May 26, 1925. 252,679.

10,220. British Thomson-Houston Company, Limited. Method of protecting metals against oxidation at high temperatures. April 17, 1925. 250,975.

14,335. Metallbank und Metallurgische Ges. Akt.-Ges. Process for desulphurising fine iron pyrites. July 4, 1925. 254,691.

17,343. Swan, Hunter, & W. Richardson, Limited, and Hunter, N. M. Advancing and retracting metal plates to and from shearing, cutting, and similar machines. July 10, 1926. 267,771.

18,515. Krupp Grusonwerk Akt.-Ges., F. Processes for the extraction of lead and zinc from ores. August 8, 1925. 256,601.

20,290. Plibrico Jointless Firebrick Company. Furnace settings. November 9, 1925. 260,953.

22,347. British Thomson-Houston Company, Limited. Protective means for electric furnaces. September 10, 1925. 258,277.

28,728. Vereinigte Stahlwerke Akt.-Ges., and Wilberz, J. Foundry plant. November 15, 1926. 267,842.

31,250. International General Electric Company, Inc. Electric furnaces. December 9, 1925.

29,104. Ryner, A. Moulds for casting metals. November 18, 1925. 267,997.

32,778. Wisner, C. B. Rotary furnaces. (January 13, 1925.) 246,118.

7,560. Ellis, J. V., and United Steel Companies, Ltd. Method of and apparatus for treatment of steel ingots. March 18, 1926. 268,123.

11,441. British Thomson-Houston Co., Ltd. Metal-tubing machines. (April 30, 1925.) 251,655.

18,262. Corson, M. G. Copper alloys. July 21, 1926. 268,200.

18,333. Job, W. Process of and apparatus for the treatment of zinc ores and etc. July 22, 1926. 268,201.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The end of the holiday break has so far brought little change in the position of the Cleveland iron trade, which remains as quiet, if not less active, than was previously reported. These conditions, it must be feared, will prevail until market offerings reach much lower levels than those now available, makers contending that it is quite impossible to quote lower figures while fuel costs continue at the present excessive rates. There are now, however, more hopeful signs of cheaper fuel in the near future, there being a disposition on the part of producers to make concessions for forward contracts. This, it may be hoped, will in turn enable smelters to lower their quotations. Current prices are:—No. 1, 82s. 6d.; No. 3 G.M.B., 80s.; No. 4 foundry, 79s.; No. 4 forge, 78s. 6d. per ton.

Business in the Tees-side hematite market moves very slowly, and producers are keen to get orders on their books. Consequently, while East Coast mixed numbers are still quoted at 83s. per ton, this figure is only weakly held, and any substantial business could be effected at a lower figure. On the North-West Coast prices are steady, with Bessemer mixed numbers quoted at £4 14s. 6d. per ton, delivered at Glasgow, £4 15s. 6d. per ton delivered at Sheffield, and £5 1s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—Business in the local markets for foundry pig continues slow, with prices practically unaltered. Between 89s. and 90s. per ton delivered locally is the range of quotations for Derbyshire and Staffordshire brands of pig-iron. Cleveland No. 3 delivered is also about unchanged at 92s. 8d. Scottish makes, however, have shown marked easiness, down to 102s. per ton delivered being quoted for common brands.

THE MIDLANDS.—Buying from hand to mouth is now the rule in this area; transactions, therefore, are for very small tonnages. The price of Derbyshire and North Staffordshire No. 3 foundry iron is between 81s. and 82s. 6d., and Northants 78s. to 79s., all f.o.t. furnaces. Lincolnshire No. 3 is also available, the ruling figure being 92s. 6d. per ton delivered Black Country sidings. The price for Scotch iron varies from £5 5s. to £5 7s. 6d. delivered.

SCOTLAND.—There is all-round quietness prevailing in the Scotch pig-iron market, and business is confined to narrow limits. Prices continue to decline, and at the moment No. 3 Scotch foundry iron is quoted at 84s. at furnaces.

Finished Iron.

Conditions in most of the manufacturing branches continue unsatisfactory, and the lower prices for crown iron are not having the effect of bringing about more business. There is plenty of competition for the small quantities of crown iron available, with works outside the district just as anxious as the Staffordshire makers for the orders.

Steel.

Very few transactions of importance can be noted in the week's steel markets, buying having been restricted greatly by holiday influences. In semi-products the only change of any significance is a further weakening of Continental soft semis, which are now to be had at as low as £5 9s., which gives a very considerable margin below the nominal British price of corresponding grade of material. The tin-plate market is inactive, with export inquiries unimportant in volume. The home trade is buying very cautiously for near dates only, on a basis of 19s. 6d. to 19s. 7½d. for coke primes, and 18s. 6d. basis for wasters in best sizes, net cash, f.o.t. at works.

Scrap.

Reports from the various centres of trade in scrap metal mostly indicate slow business, with a general weakening of current prices. In Scotland heavy machinery cast-iron scrap, suitable for foundries and in pieces not exceeding 1 cwt., is still easy around 78s. 6d. to 80s. per ton, and for heavy ordinary cast to the same specification around 75s. per ton. On account of the supply and demand, old cast-iron railway chairs are around 80s. to 81s. 3d. per ton, which appears to be rather high as compared with the price of machinery metal. Light cast-iron scrap and fire-bars are 57s. 6d. to 58s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—The only exception to the general weakening of values in the markets for base metals was the comparative steadiness of standard copper, which closed fractionally stronger at the week-end. The position is due to a slow Continental demand, apart from German buying, which is on a small, although steady, scale; the reduction has up to now been ineffective in inducing consumers to cover their needs.

Official closing prices of standard copper have been as follow :—

Cash : Thursday, £55 6s. 3d. to £55 7s. 6d.; Friday, £55 7s. 6d. to £55 8s. 9d.; Monday, £54 15s. to £54 17s. 6d.; Tuesday, £54 16s. 3d. to £54 17s. 6d.; Wednesday, £54 15s. to £54 16s. 3d.

Three Months : Thursday, £55 18s. 9d. to £56; Friday, £55 17s. 6d. to £55 18s. 9d.; Monday, £55 7s. 6d. to £55 10s.; Tuesday, £55 7s. 6d. to £55 8s. 9d.; Wednesday, £55 6s. 3d. to £55 7s. 6d.

Tin.—Although quotations for standard tin have now descended to lower levels than have been marked for some time, the depression is not expected to be more than temporary, and a reaction in values may be confidently anticipated by the end of the month.

According to official returns, the output in the Federated Malay States for March was 3,988 tons, as against 3,279 tons for February, making the total for the first quarter 11,286 tons, which shows only a slight increase as compared with the same period last year, but a small decrease against 1925.

Official closing prices of standard tin have been as under :—

Cash : Thursday, £298 5s. to £298 10s.; Friday, £295 to £295 5s.; Monday, £294 to £294 5s.; Tuesday, £294 5s. to £294 7s. 6d.; Wednesday, £296 to £296 5s.

Three Months : Thursday, £293 15s. to £294; Friday, £291 7s. 6d. to £291 10s.; Monday, £290 15s. to £291; Tuesday, £290 5s. to £290 10s.; Wednesday, £291 17s. 6d. to £292.

Spelter.—Fluctuations in spelter values of late have been mostly confined within narrow limits, and, considering the active speculative interest taken in the metal, the position may be regarded as fairly steady. The outlook may be regarded as rather uncertain, but it is not expected that prices will fall much lower, while they would respond quickly to more active buying on the part of galvanisers.

The following are the week's prices :—

Ordinary : Thursday, £29 10s.; Friday, £29 7s. 6d.; Monday, £29 2s. 6d.; Tuesday, £29 2s. 6d.; Wednesday, £29 5s.

Lead.—The market for soft foreign pig has been depressed on account of weaker advices from the United States. The weight of arrivals is still rather ominous, but it is hoped that the cable makers will shortly re-enter the market, when a change for the better would quickly ensue.

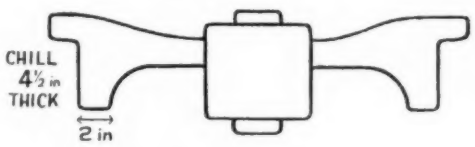
The week's prices are appended :—

Soft foreign (prompt) : Thursday, £26 6s. 3d.; Friday, £26 1s. 3d.; Monday, £25 12s. 6d.; Tuesday, £25 18s. 9d.; Wednesday, £25 16s. 3d.

Foundry Query.

Chilling Wheel Treads.

Could you give me any advice on the chilling of cast-iron wheels up to 3 cwts. to get a hard face? The wheels are 2 ft. in diameter, 4-in. tread, boss 7 in. diameter, 6½ in. through, plate 1½ in. thick., tread 2 in. thick. The method I



have adopted is chilling the tread in casting and parting the chill when cool.

Would you advise cooling the tread by sprinkling with water or just exposing the tread to cold air? Do you think it possible to keep the heat from returning back to the tread of the wheel before the boss of a wheel of this thickness cools sufficiently to maintain a hard face on the tread of the wheels?—H. Smith.